JUNE 1950

CIVIL ENGINEERING

THE MAGAZINE OF ENGINEERED CONSTRUCTION

ECHNOLOGY DEPT.

PUBLIC LIBRARY
JUN 13 1950
DETROIT

FINANCIAL SUCCESS of Pennsylvania Turnpike encourages more toll roads. Construction of Turnpike's Eastern Extension, to be in operation this year, is speeded by highly mechanized pavement placing methods of contractor, Langenfelder Company. See articles by Farley Gannett and Charles M. Noble.

Gulf of California No Overflow Threat to Imperial Valley—Lawson

Traffic Stopped Only 30 Hours on 3-Year Tombigbee RR Bridge Job—Barnard

ASCE Summer Convention in Toronto, Canada—July 12-14, 1950

AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852

RAYMOND

SERVING GULF OIL FOR 40 YEARS

THROUGH THE YEARS, the Gulf Oil Corporation has called in Raymond again and again to expand its facilities. For example:

At Gulf's pipeline terminal in Port Arthur, Texas, Raymond completed in 1911 a marginal wharf 25 feet wide and 1083 feet long. Later two similar sections were added to make the wharf more than a half mile long. Last year Raymond reinforced the existing wharf with reinforced concrete and constructed a new wharf 35 feet wide along its entire face—doubling the deck area and permitting deeper dredging to accommodate large vessels. The job was completed well ahead of schedule and with a minimum of interference with Gulf's normal docking operations.

Gulf Oil is one of the leading oil companies which have consistently turned to Raymond for important foundation and structural projects. This wealth of experience is at your disposal.

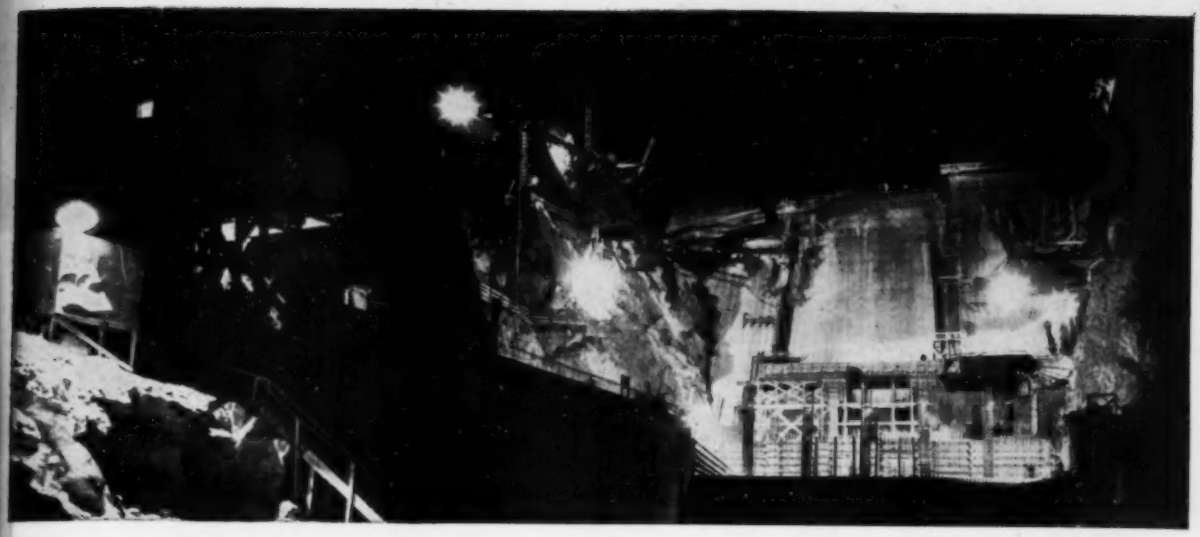
THE SCOPE OF RAYMOND'S ACTIVITIES—includes every recognized type of pile foundation—concrete, composite, precast, steel, pipe and wood. Also caissons, underpinning, construction involving shore protection, shipbuilding facilities, harbor and river improvements, borings for soil investigation, and cement mortar lining of pipes by the Centrifoam Corporation, a Raymond Subsidiary.

RAYMOND CONCRETE PILE COMPANY

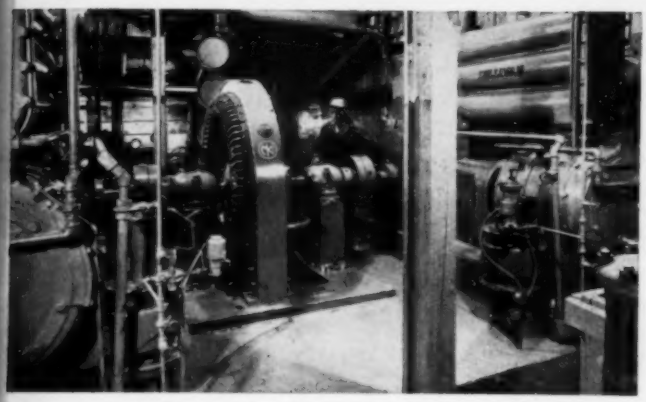
140 CEDAR STREET, NEW YORK 6, N. Y.

BRANCH OFFICES: Boston, Syracuse, Philadelphia, Baltimore, Washington, Pittsburgh, Atlanta, Miami, Houston, Kansas City, St. Louis, Cleveland, Chicago, Detroit, Salt Lake City, Portland, San Francisco, Oakland, Los Angeles and principal cities in Latin America.

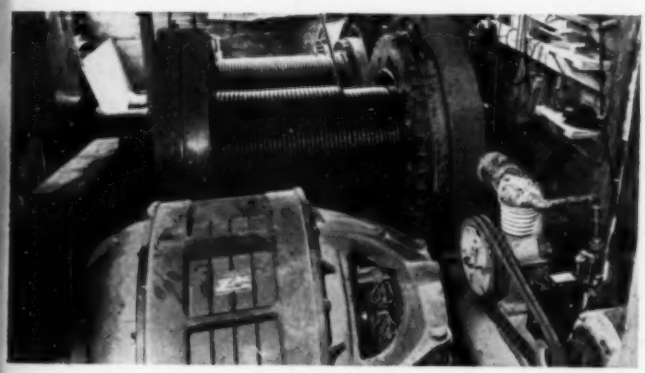
Section of wharf being constructed between two completed sections.



speeding construction at Kortes Dam



All air pressure for job comes from compressors driven by a 500-hp G-E motor.



The 185-foot boom hoist is driven by a 200-hp General Electric induction motor.

... Electrically

G-E Equipment Operates Around the Clock to Meet Schedule

To maintain their rigorous work schedule at the Bureau of Reclamation's Missouri-Basin Kortes Dam project (Kortes, Wyoming), Morrison-Knudsen Co., contractors, must keep on the job 24 hours a day. Thanks to modern machinery *electrified by General Electric*, work proceeds at this accelerated pace without the periodic shutdowns usually expected in this kind of job.

When you electrify with G-E motors and control supplied from G-E power distribution systems, you get safer, faster, more efficient operation. You'll also have the added advantage of engineering assistance in application, installation, and service—regardless of job location. *Apparatus Dept., General Electric Co., Schenectady 5, N. Y.*

Ask him Today!

Whether you buy or build construction equipment, your G-E representative can show you how to do a better job—at lower cost—by complete electrification. Write him now, and he'll call on you at your convenience.

GENERAL ELECTRIC

664-9

CIVIL ENGINEERING, June, 1950. Vol. 20, No. 6. Published monthly by the American Society of Civil Engineers. Publication office 20th and Northampton Streets, Easton, Pa. Editorial and advertising departments at the headquarters of the Society, 33 West 39th Street, New York, N. Y. Price 50¢ a copy, $5.00 a year in advance, $4.00 a year to members and to libraries and $2.50 a year to members of Student Chapters. Canadian postage 75¢ and foreign postage $1.50 additional. Entered as second class matter September 23, 1930, at the Post Office, Easton, Pa., under the Act of August 24, 1912, and accepted for mailing at a special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 5, 1918.

We pause to ref

Come
jobs

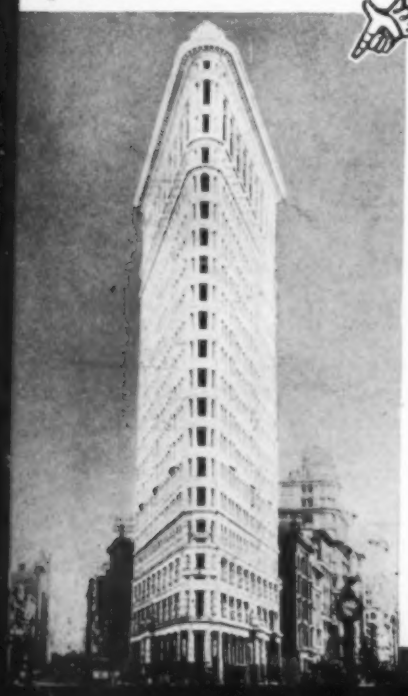
On May
day. Bu
of struct
form Am
in the co
On th
fabricate
Unfortun
steel stru
operation
and Proc

Contract

SAN FRANCISCO-OAKLAND BAY BRIDGE Completed in 1936, this is the world's greatest bridge. It is 8¼ miles between terminals, of which 4¼ miles is steel superstructure over the waters of San Francisco Bay.

EMPIRE STATE BUILDING The Empire State Building was fabricated by American Bridge Company in 1930. It is the tallest structure ever built, towering 1250′ above the street level—86 stories topped by a 55′ penthouse section and a 150′ airship mooring mast.

THE FLATIRON BUILDING The Flatiron Building (Fuller) in New York City was fabricated by American Bridge Company in 1901. When completed in 1902, it was perhaps the tallest skyscraper built up to that time.



A representative list of other American Bridge Company structures:

FABRICATED AND ERECTED

Atbara River Bridge
Anglo-Egyptian Sudan, Africa

Blue Water Bridge
St. Clair River, Pt. Huron, Mich.

Bronx-Whitestone Bridge
East River, New York

Carquinez Strait Bridge
Crockett, Calif.

Charter Oak Bridge
Conn. River, Hartford, Conn.

Delaware River Suspension Bridge
Philadelphia, Pa.

Florianopolis Bridge
Santa Catharina Is., Brazil.

Henry Hudson Bridge
New York City

Huey P. Long Bridge
Miss. River, New Orleans, La.

Lake Union Bridge
Seattle, Wash.

Thousand Islands Bridge
St. Lawrence River, N. Y.

Will Rogers Stadium
Broadmoor, Colo.

FABRICATED

Atlantic City Convention Hall
Atlantic City, N. J.

Carew Building
Cincinnati, Ohio

Chicago Post Office
Chicago, Ill.

Chrysler Building
New York City

Cleveland Municipal Stadium
Cleveland, Ohio

Grand Central Station
New York City

Outer Drive Bascule Bridges
Chicago, Ill.

Rockefeller Center—9 Buildings
New York City

Russ Office Building
San Francisco, Calif.

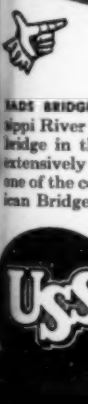
Stevens Hotel
Chicago, Ill.

Wanamaker Stores
Philadelphia & New York

Woolworth Building
New York City

Yankee Stadium
Bronx, New York City

THE HELL GATE BRIDGE Completed in 1917, this bridge, over the East River between Wards Island and Long Island, New York, was the largest arch span ever built up to that time.



o reflect on 50 Busy Years

Come take a glance at just a few of the many jobs we have done over the past half century.

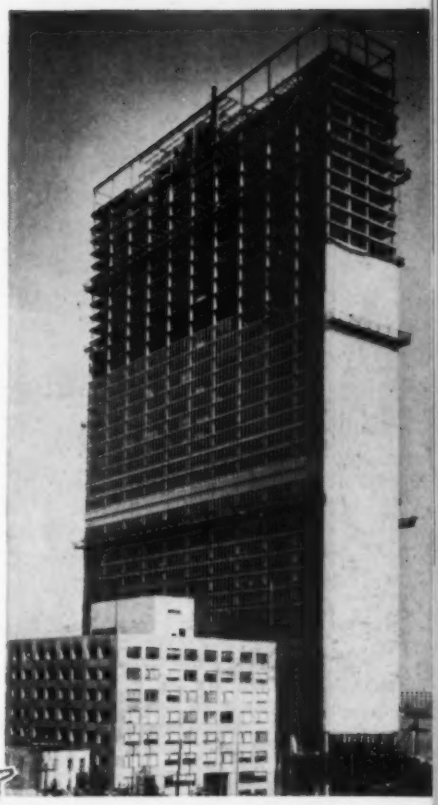
On May 12 the American Bridge Company celebrated its Fiftieth Birthday. But its structural steel experience and know-how are as old as the use of structural steel, and older. For the companies which merged in 1900 to form American Bridge Company brought with them a wealth of experience in the construction of all types of structures.

On these pages are shown but a few of the larger buildings and bridges fabricated, and in many instances, erected by American Bridge Company. Unfortunately space does not permit telling about the thousands of smaller steel structures which comprise a very important part of our Company's operations. For a more comprehensive picture, write for the booklet "Plants and Products—American Bridge Company." It is yours for the asking.

AMERICAN BRIDGE COMPANY

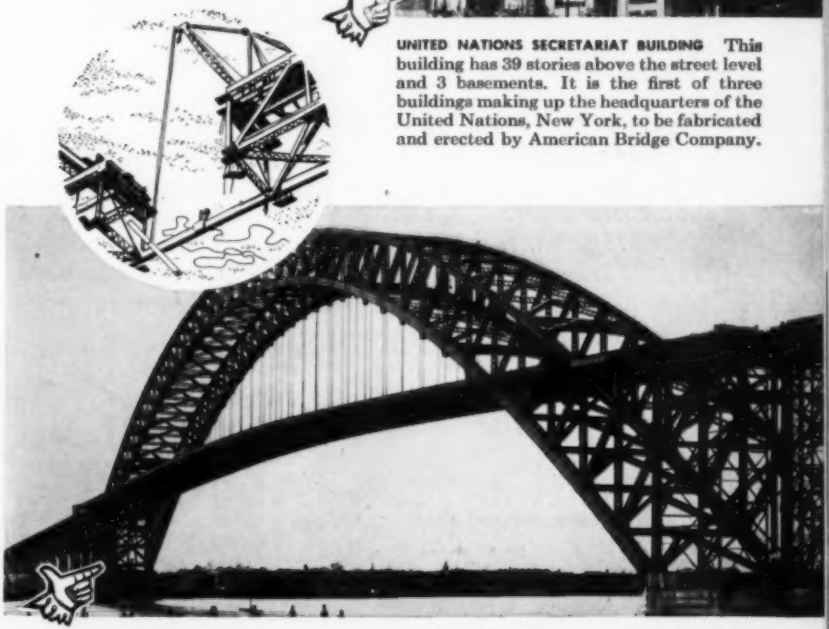
General Offices: Frick Building, Pittsburgh, Pa.

Contracting Offices in: AMBRIDGE · BALTIMORE · BOSTON · CHICAGO · CINCINNATI · CLEVELAND · DENVER
DETROIT · DULUTH · ELMIRA · GARY · MINNEAPOLIS · NEW YORK · PHILADELPHIA
PITTSBURGH · PORTLAND, ORE. · ST. LOUIS · SAN FRANCISCO · TRENTON
UNITED STATES STEEL EXPORT COMPANY, NEW YORK



UNITED NATIONS SECRETARIAT BUILDING This building has 39 stories above the street level and 3 basements. It is the first of three buildings making up the headquarters of the United Nations, New York, to be fabricated and erected by American Bridge Company.

EADS BRIDGE Built in 1868-74 across the Mississippi River at St. Louis, Missouri, it was the first bridge in the United States in which steel was extensively used. The Keystone Bridge Company, one of the companies in the merger to form American Bridge Company in 1900, built this bridge.



THE BAYONNE BRIDGE The Bayonne Bridge, spanning the Kill van Kull, was fabricated and erected by American Bridge Company. It was completed in 1931. This bridge has the longest arch span in the world.

USS

AMERICAN BRIDGE

UNITED STATES STEEL

Detroit *Doubling* Its Yardage of CONCRETE Street Paving

Typical residential street design, showing standard 8-6-8 cross-section with the integral curb acting as the outer edge thickening. Roll integral curb detail is shown at the left.

DETROIT is carrying on one of the most ambitious concrete street paving programs any city ever has undertaken. Starting in 1946 with 275,407 sq.yd. of concrete paving, the program expanded into 622,176 sq.yd. in 1947 and then rose again to 1,129,740 sq.yd. in 1948 and 1,423,869 sq.yd. in 1949. The paving program in 1950 is expected to continue at the same rate of the past two years.

This will virtually double the 4,371,208 sq.yd. of concrete street pavement existing in Detroit in 1945—an amount which had already placed Detroit among the top ten cities in concrete street yardage.

According to City Engineer George R. Thompson, Detroit chose concrete for this gigantic program of residential street paving because compared with other pavement suitable for prevailing conditions and types of traffic it was (1) lower in first cost, (2) lower in maintenance cost and (3) longer lived. These three features of concrete will give Detroiters true ***low-annual-cost*** pavement.

Detroit kept paving costs low in two ways. First, it advertised street projects individually but let them in groups having sufficient yardage to be attractive to contractors. Second, it employed street designs featuring well-balanced jointing arrangement and low-cost, roll-type integral curb.

For complete information on the design technique for modern city streets, write for a free copy of *"The Design of Concrete Pavements for Municipal Streets."* Distributed only in the United States and Canada.

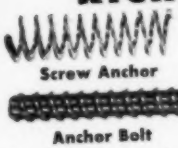
PORTLAND CEMENT ASSOCIATION
DEPT. 6-13, 33 WEST GRAND AVENUE, CHICAGO 10, ILLINOIS

A national organization to improve and extend the uses of portland cement and concrete through scientific research and engineering field work

ENGINEERED TYING DEVICES, ANCHORAGES and ACCESSORIES for CONCRETE CONSTRUCTION

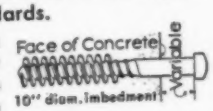
FOR DEPENDABLE ANCHORAGE TO CONCRETE

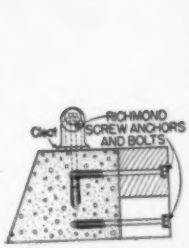
RICHMOND SCREW ANCHORS & BOLTS



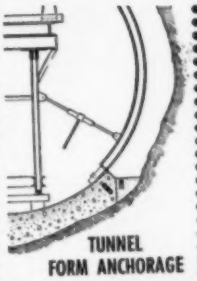
For permanent or temporary anchorage to concrete. Anchors cleats, bollards and fender system to concrete piers and docks. Holds form loads of cantilever forms and heavy steel tunnel forms. Supports form loads on brackets for high slabs and heavy pier spandrels. Lifts piles with detachable lifting eye bolts. Fastens seat brackets to concrete stadiums and wood slats to concrete park bench standards.

Screw Anchors are made for bolt diameters up to 1½ inch

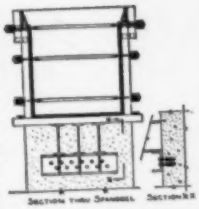




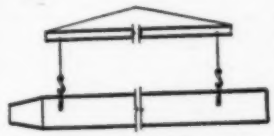
PIER BULKHEAD DETAIL



TUNNEL FORM ANCHORAGE

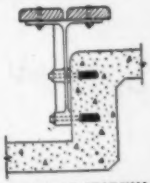


SPANDREL BEAM SUPPORT

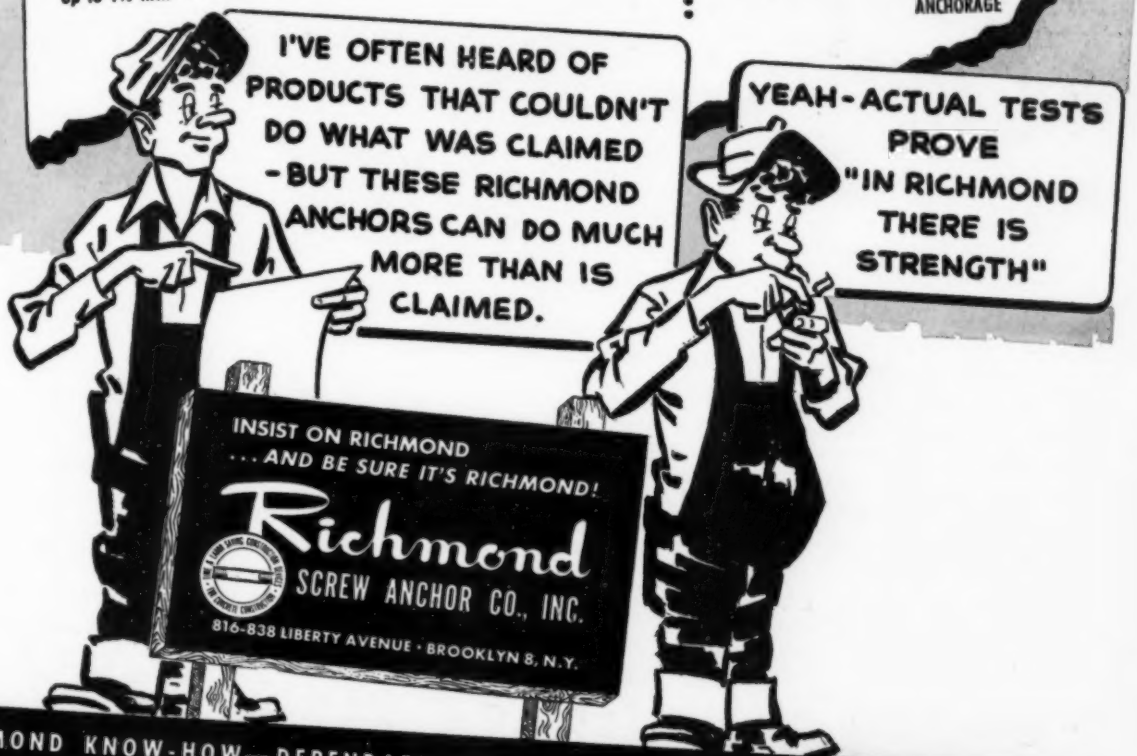


CONCRETE PILE LIFTING DETAIL

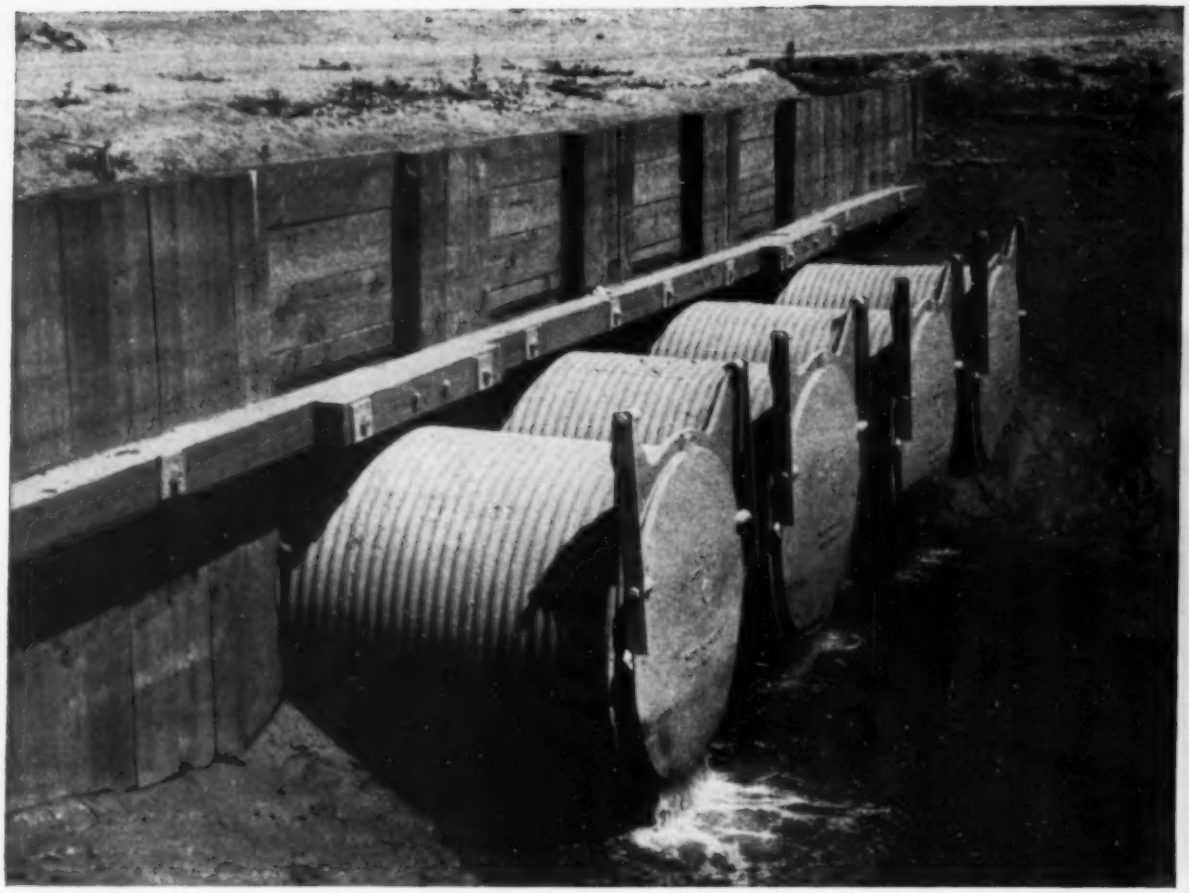
DETAIL OF CONCRETE BENCH SUPPORT



DETAIL OF STADIUM SEAT BRACKET ANCHORAGE


I'VE OFTEN HEARD OF PRODUCTS THAT COULDN'T DO WHAT WAS CLAIMED - BUT THESE RICHMOND ANCHORS CAN DO MUCH MORE THAN IS CLAIMED.
YEAH - ACTUAL TESTS PROVE "IN RICHMOND THERE IS STRENGTH"
INSIST ON RICHMOND
... AND BE SURE IT'S RICHMOND!
Richmond
SCREW ANCHOR CO., INC.
816-838 LIBERTY AVENUE · BROOKLYN 8, N.Y.

RICHMOND KNOW-HOW—DEPENDABILITY—SERVICE—ESTIMATES & JOB PLANNING



It's an open and shut case OF WATER CONTROL

There's no mystery to protecting valuable property from harmful backwater. It's an open and shut case of water control with Armco Drainage Gates. These gates permit free outflow with positive action to prevent backflow.

Armco Drainage Gates are easy to install on corrugated metal pipe or concrete headwalls of drainage outlet structures. Their rugged, all-metal construction assures many years of continued service without repair or replacement.

There is a type and size of Armco Gate for practically every requirement . . . automatic flap gates that open and close without supervision; slide gates for light and heavy duty; and radial gates for maintaining constant water levels. They can be adapted to circular or rectangular openings. Sizes are 8 to 96 inches square or 8 to 120 inches in diameter. Radial gates are 2 to 12 feet high; 4 to 30 feet long.

You'll find Armco Drainage Gates a good investment for drainage, flood control, irrigation, sewer outfalls and wherever else water needs to be controlled. Write for prices and complete design data. Armco Drainage & Metal Products, Inc., 5020 Curtis Street, Middletown, Ohio. Subsidiary of Armco Steel Corporation.

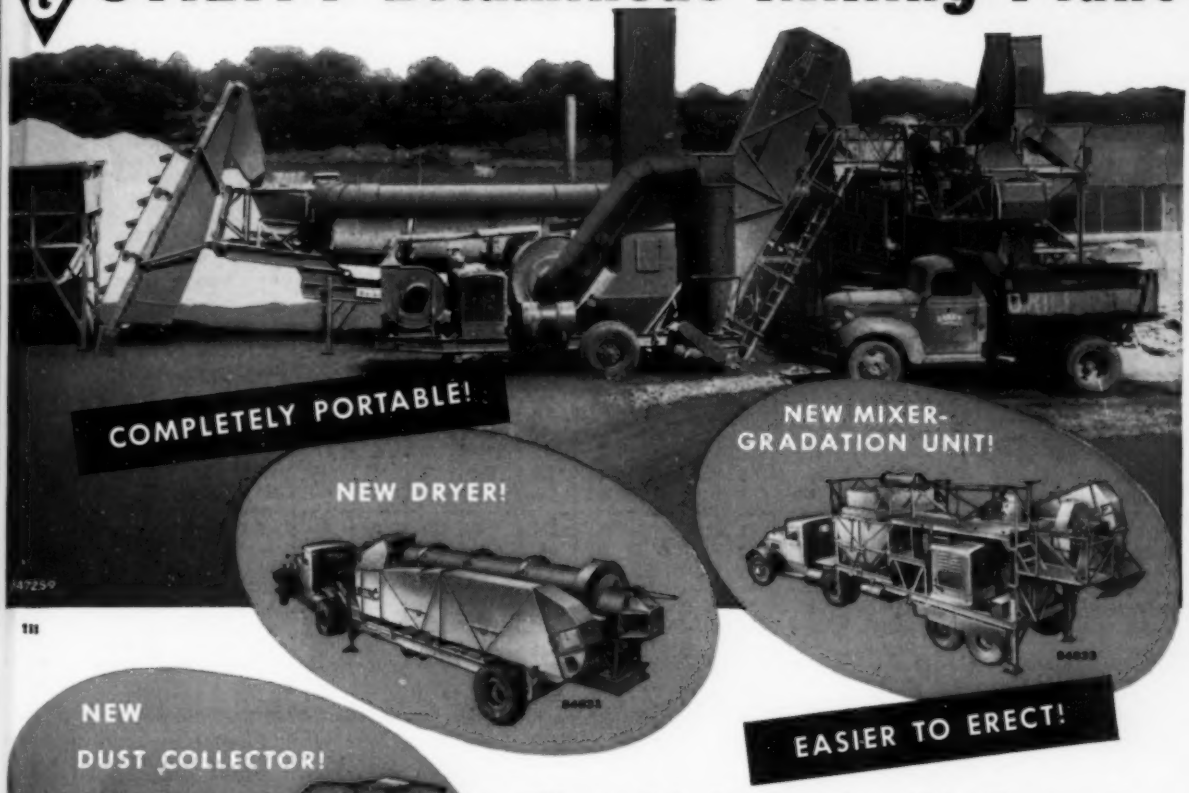
Export: The Armco International Corporation

ARMCO DRAINAGE GATES

ARMCO

Barber-Greene

UTILITY Bituminous Mixing Plant



SOME OF MANY REVOLUTIONARY FEATURES!

- ***True portability*** **in every unit**
  Faster erection **without cranes or heavy equipment**
- ***No cribbing*** **necessary**
- ***Adaptability*** **to widest variety of jobs and mixes**
- ***Built-in*** **Gradation Control**
- ***Built-in*** **Elevators on Dryer and Mixer**
- ***High Discharge Dryer*****—eliminates hot elevator pit**
- ***Two, three*** **or** ***four-bin*** **aggregate gradation**

This new Barber-Greene Bituminous Mixing Plant was developed to meet specifically the need for a more completely portable, easier-to-erect plant with a capacity in the 60-ton per hour range. Here is a plant that makes the most of manpower — that minimizes the time required for setting up or dismantling — yet retains all the basic B-G advantages of accurate volumetric measurement and proportioning of aggregate and bitumen. The Utility Plant is all this and more, for it can be adapted to produce a constant flow of all types of mixes including the highest types. Each of its basic units incorporates new improvements in design to achieve the maximum in portability, simplicity in erection and operation.

Before bidding on any bituminous job, get full information on this new, advanced design Utility Plant. Use the coupon or see your Barber-Greene distributor for your copy of Bulletin 845.

SEND FOR NEW BULLETIN!

BARBER-GREENE COMPANY
AURORA, ILLINOIS

Send copy of Bulletin 845

Name .....

Firm Name .....

City ..... **State** .....

CHECK THESE FACTS ON DORR CLARIFIER PERFORMANCE!

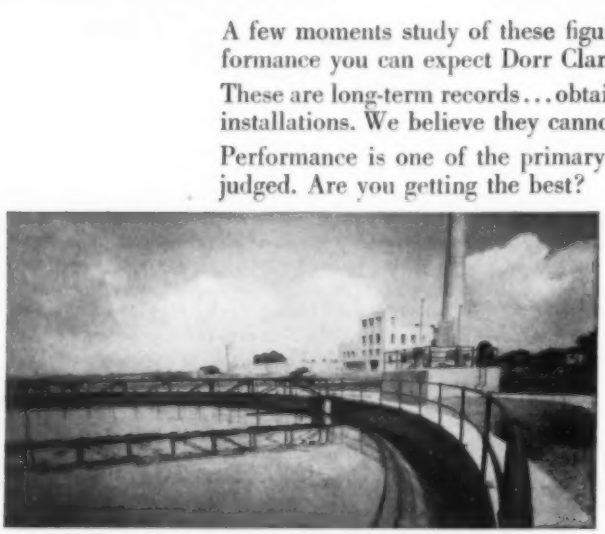
OPERATING DATA DORR SIFEED CLARIFIERS—RADIAL FLOW—ROUND OR SQUARE

Location	No. Yrs.	Data Period	Ave. Flow MGD	Clarifiers			Det. Hrs.	O'Flow Gal.	Susp. Solids			Sludge		B.O.D.		
				No.	Size	W.D.			Raw	Eff.	% Rem.	% Sol.	% VM	Raw	Eff.	% Rem.
Washington, Blue Plains Plt.	2	1944-45	136.3	12	106′ Dia.	14	1.88	1350	163	83	49	8.05	67.5	173	120	30.5
Gary, Ind.	4	1941-44	28.11	4	75′ Sq.	10	2.0	900	265	104	61	5.32	63	148	72	47.2
Winnipeg, Man.	2	1943-44	22.8	2	115′ Dia.	12	1.98	1100	348	159	55	9.0	70.5	310	231	25.5
Battle Creek, Mich.	5	1938-42	4.92	2	80′ Dia.	10	3.66	490	282	85	70	5.5	82.5	264	174	34.1
Buffalo, N. Y.	3	1939-41	135	4	160′ "	15	1.6	1690	209	114	46	5.77	59	138	107	22.5
Albuquerque, N. M.	7	1939-46	5	1	80′ "	12.2	2.21	995	254	91	61	3.90	81	282	150	44.5
Yakima, Wash.	1	1942	9.5	4	90′ "	9	4.32	373	110	23	74	6.98	74.4	175	92	50
Appleton, Wis.	7	1938-45	4.8	2	70′ "	10	2.90	623	276	63	77	5.6	58	284	141	50
Baltimore, Md.	4	1939-44	89.5	3	170′ "	12	1.64	1360	214	83	61	3.9	82.7	281	204	27.5
Springfield, Ohio	4	1937-40	14.0	2	90′ "	10	1.55	1160	166	63	62	—	—	90	43	52
Mansfield, Ohio	2	1944-45	3	1	65′ "	12	2.38	905	208	87	58	4.2	76	227	139	38.8
Cedar Rapids, Ia.	9	1936-44	4.21	1	70′ "	11.5	1.95	1060	354	132	63	5.5	81.2	383	291	24
Austin, Texas	2	1944-45	5.64	1	75′ "	12	1.89	1275	263	95	64	4.0	83	285	152	46.3
Neenah-Menasha, Wis.	4	1942-45	7.93	2	75′ "	10	1.0	1790	681	188	72	—	—	—	—	—
Denver, Colo.	5	1939-43	46	4	140′ "	9.7	2.34	750	187	44	77	5.4	76	212	108	49
Sheboygan, Wis.	1	1944	6.4	2	80′ "	10	2.8	635	342	60	82	7.2	61.1	513	285	44
Ypsilanti, Mich.	3	1943-45	1.66	2	40′ "	9	2.5	660	226	87	62	8.2	71.4	141	95	33
Monroe, Mich.	8	1938-46	4.3	2	85′ "	7.5	3.55	378	329	75	77	5.23	67.7	135	73	46

A few moments study of these figures will give you a clear idea of what kind of performance you can expect Dorr Clarifiers to deliver.

These are long-term records... obtained by competent plant chemists at well established installations. We believe they cannot be bettered.

Performance is one of the primary factors upon which Clarifier excellence should be judged. Are you getting the best?



Close-up of peripheral overflow from one of four 160′ dia. Dorr Sifeed Clarifiers at Buffalo, N. Y.

We'd like to give you some figures on Dorr Clarifier repair costs too. Ask a Dorr engineer for the facts.

DORRCO

THE DORR COMPANY, ENGINEERS
BARRY PLACE, STAMFORD, CONN.
NEW YORK • ATLANTA • TORONTO
CHICAGO • DENVER • LOS ANGELES
RESEARCH AND TESTING LABORATORIES
WESTPORT, CONN.
SUGAR PROCESSING
PETREE & DORR DIVISION, STAMFORD, CONN.
ASSOCIATES AND REPRESENTATIVES
Dorr Technical Services and Equipment Are Also Available Through Associated Companies and Representatives in the Principal Cities of the World. Names and Addresses on Request.

DORR

RESEARCH ENGINEERING EQUIPMENT

Easy street . . .

• Easy to build, easy to maintain, easy to travel . . . these are the benefits for road-builder and for road-traveller when Main Street or highway is resurfaced with asphalt.

EASY TO BUILD—Easier laying of asphalt, use of faster equipment, rapid setting of asphalt paving . . . all of these help to speed road construction and to keep man-hours at a minimum. Aggregate that is already on the road or close at hand can be used to make the job still easier and to hold material expenses at a rock-bottom low.

EASY TO MAINTAIN—Asphalt and aggregate, mixed, make strong and durable road foundations. Top courses of asphalt, stone, and sand present long-wearing, waterproof surfaces. Maintenance, when necessary, takes a minimum of time, labor, and materials.

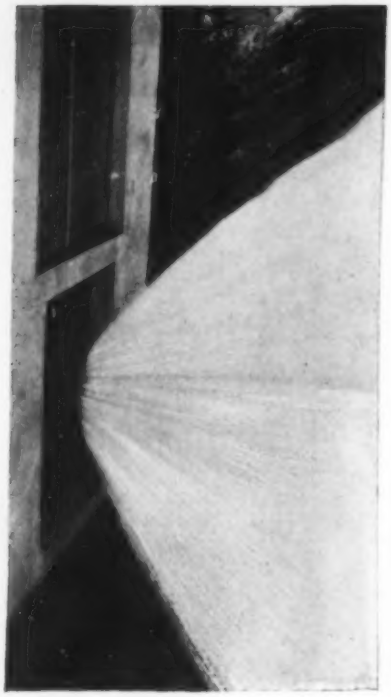
EASY TO TRAVEL—The unbroken, black surfaces of asphalt provide smooth-riding travel for users. The absence of road glare makes driving easier and safer.

A Standard Oil Asphalt Department Representative can suggest economical types of asphalt construction to meet your needs and local conditions. You are assured prompt delivery of Standard Oil Asphalt from any of five large refineries located throughout the Midwest. Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

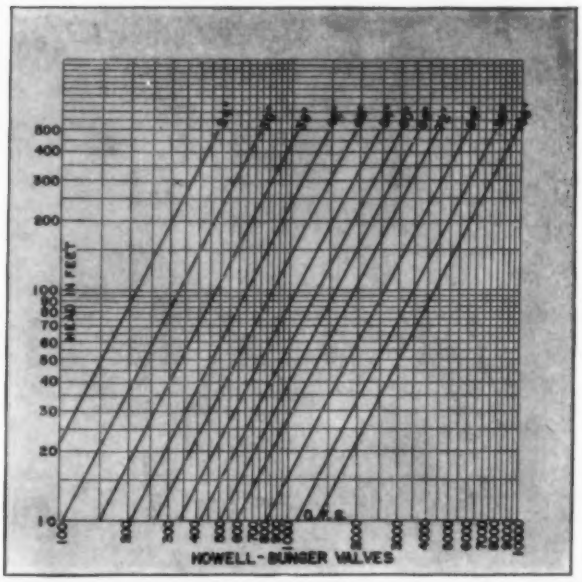
STANDARD OIL

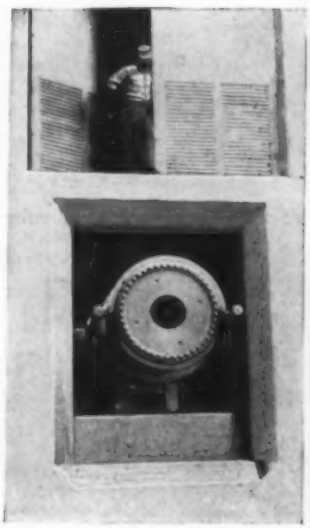
ASPHALT

TANDARD OIL COMPANY (INDIANA) STANDARD



for FREE DISCHARGE
These Pictures *and* Graph Tell the Story-





Howell-Bunger Valve

If It's Hydraulics~ Put It Up to Us!

HIGH DISCHARGE efficiency, simplicity of design and low cost are the outstanding advantages of this unusual Valve, described in Bulletin No. 144. Send for it.

S. MORGAN SMITH Co.
YORK, PENNA. U.S.A.

The fleet that won a land battle

It took a fleet of 8 "Caterpillar" DW10s to lick a long-haul earthmoving problem for Parish Brothers, Benicia, California.

Bill Madsen, job superintendent on this contractor's "Black Point Cutoff" job north of San Francisco, summed it up this way: "Our DW10s performed so well that our original equipment specifications were changed to make it a DW10 show all the way! Down time is remarkably low, and we're ahead of schedule."

The 404,000 cu. yd. "Black Point Cutoff" poser —with a one-way haul distance of 3.1 miles—was licked like this: No. 80 "Caterpillar" Scrapers were pusher-loaded with 12½ pay yards in 0.9 minute or less. . . . The DW10s handled spreading on the fly in 10 seconds . . . hauling speeds averaged 20 mph. over mostly level to favorable grade . . . complete unit cycle made every 16 minutes . . . production averaged 46 pay yds. an hour per unit.

The DW10 excels at low-cost, high-speed earthmoving. All-"Caterpillar" built and serviced, its 115-hp. "Cat" Diesel Engine holds hauling speeds up to 24.5 mph. DW10 bonus features include aluminum pistons with cast iron band for top compression ring, "Hi-Electro" hardened final drive gears, hydraulically controlled seat, booster steering for finger-tip control, and easy-to-operate constant-mesh transmission.

Ask your "Caterpillar" dealer to show you what the DW10 can do for you.

CATERPILLAR TRACTOR CO. • PEORIA, ILLINOIS

LOOK UNDER THE HIDE

Quality doesn't show on the outside— it shows up in performance

"Caterpillar" cylinder heads are made of copper-molybdenum iron. Built with rugged reinforcing members, the head design gives large air ports for maximum engine power. Ample spacing between valves and wide water passages prevent steam pockets—offer utmost resistance to cracking—give long head life. Water passages are designed to guide the water next to valve seats and precombustion chambers to keep head temperatures uniform. *Look under the hide for quality.*

CATERPILLAR

REG. U. S. PAT. OFF.

DIESEL ENGINES • TRACTORS • MOTOR GRADERS • EARTHMOVING EQUIPMENT

acids can't affect CLAY PIPE

VITRIFIED CLAY PIPE provides the only *sure* protection against costly, dangerous acid attack. "Inside and out," it's chemically inert — absolutely immune to corrosion, rust, or decomposition. In a recent survey of 122 leading American cities, it was found that 89% of the existing sewers are Vitrified Clay Pipe lines. *And there is not one instance on record of a single length of Clay Pipe wearing out due to acid attack.* It pays to play safe . . . to guard against the dangerous acids and alkalies found in sewage and ground waters. Be *sure* by specifying Vitrified Clay Pipe — the *only* pipe that never wears out.

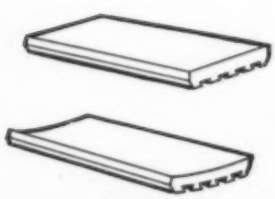
NATIONAL CLAY PIPE MANUFACTURERS, INC.
1105 Huntington Bank Bldg., Columbus 15, Ohio
703 Ninth and Hill Bldg., Los Angeles 15, Calif.
100 N. LaSalle St., Rm. 2100, Chicago 2, Ill.
206 Connally Bldg., Atlanta 3, Ga.

SPECIFY

Vitrified

CLAY PIPE

CLAY PIPE NEVER WEARS OUT!



LINER PLATES

STANDARD-STRENGTH CLAY PIPE

CLAY PIPE FITTINGS

C-250-2

Laying 4 inches of Texaco Asphaltic Concrete paving, containing low-cost local aggregate, on State Highway 29 in Texas.

Applying a hot seal coat of 175-penetration Texaco Asphalt to the asphaltic concrete surface.

Crushed gravel, heated to 375°F. is spread and rolled into the asphalt seal coat.

Completed Texaco Asphalt pavement on 12 miles of Texas Route 29, constructed by J. M. Dellinger, Inc., of Corpus Christi.

Road-building with Texaco in aggregate-poor areas

Along the Gulf Coast of Texas, the only local aggregate for highways is caliche, a relatively soft material, and sand. How these low-cost materials were used to construct 12 miles of state highway will interest road builders in other aggregate-poor areas.

For a sub-base, caliche was laid to a compacted thickness of 7 inches. Over this was constructed 4 inches of Texaco Asphaltic Concrete—caliche and sand plant-mixed with a 90-penetration asphalt. To compensate for the soft caliche, a seal coat of 175-penetration Texaco Asphalt was applied and covered with heated, crushed gravel, the only imported aggregate used.

The caliche sub-base was primed with Texaco MC-1 Cutback Asphalt. Tack coats of Texaco RC-2 Cutback Asphalt were applied between the three or four layers of asphaltic concrete.

Whatever your own road, street or airport paving problem, you will find an effective, economical solution in Texaco's complete range of Asphalt Cements, Cutback Asphalts and Slow-curing Asphaltic Oils. Refined from selected crudes, Texaco Asphalt products have helped construct and maintain America's highways for 45 years.

Two helpful booklets on asphalt construction may be secured by writing our nearest office.

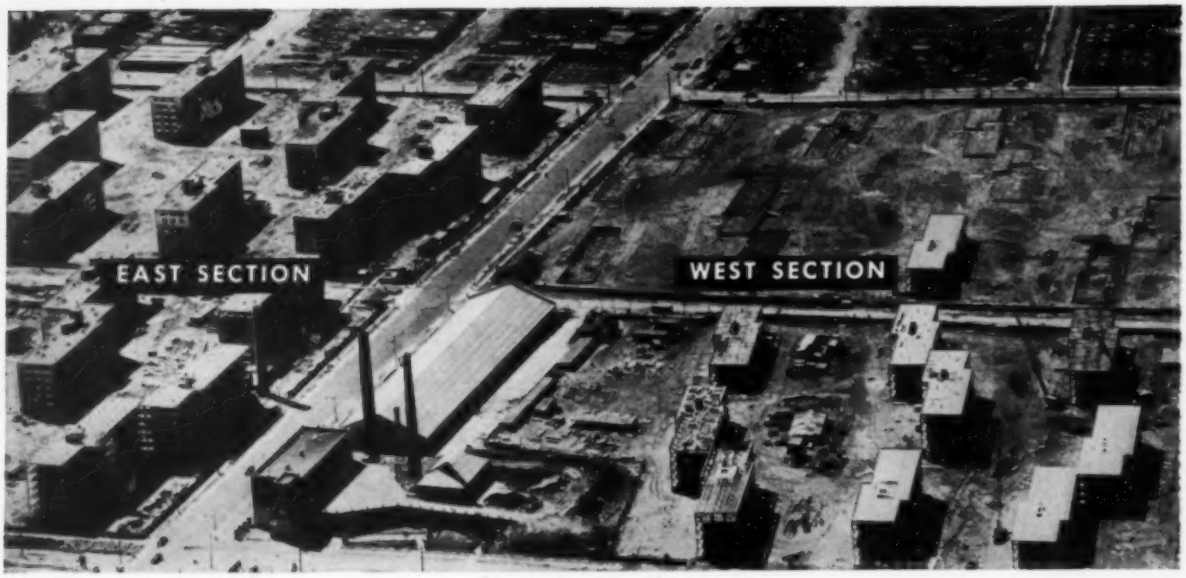
THE TEXAS COMPANY, Asphalt Sales Dept., 135 E. 42nd Street, New York City 17

Boston 16 Chicago 4 Denver 1 Houston 1 Jacksonville 2 Philadelphia 2 Richmond 19

TEXACO

REG. T. M.

TEXACO ASPHALT



High-Efficiency 'Incor' Performance

Speeds Erection of Ravenswood Houses—West Section

NEW YORK CITY HOUSING AUTHORITY
RAVENSWOOD HOUSES (West Section) Long Island City

Architect: **THE FIRM OF FREDERICK G. FROST JR.,** New York

Ready-Mix 'Incor' Concrete
COLONIAL SAND & STONE CO., INC., New York

Contractor, Concrete Frame:
CAYE CONSTRUCTION CO., INC., Brooklyn, N. Y.

● One of New York City Housing Authority's largest projects is 2166-apartment Ravenswood Houses, Long Island City. Housing Authority projects are quality-constructed in every last detail—and they move ahead at driving speed. Because at today's costs, time saved is money saved—and how!

All last winter, frame concreting on the fourteen 6-story units in Ravenswood's west section clicked ahead on precise schedule—for CAYE CONSTRUCTION CO., INC switched to 'Incor' 24-Hour Cement. In cold weather, column forms were stripped in 24 hours, slabs in 48 hours. That kept the job right on schedule—and saved a complete set of forms. *Big money, that, at today's form costs!*

Came Spring—and things were running so smoothly that they kept on using 'Incor'. For high-efficiency 'Incor' performance knows no season. Straight around the calendar, 'Incor'* promotes the smooth-running, time-saving efficiency on which today's close-margin profits depend. Send for illustrated booklet, 'Cutting Concrete Costs'—write Lone Star Cement Corporation, 100 Park Ave., New York 17.

*Reg. U. S. Pat. Off.

LONE STAR PORTLAND CEMENT
"INCOR" HIGH EARLY STRENGTH PORTLAND CEMENT
"INCOR"
LONE STAR AIR-ENTRAINING PORTLAND CEMENT
LONE STAR MASONRY CEMENT

LONE STAR CEMENTS COVER THE ENTIRE CONSTRUCTION FIELD

LONE STAR CEMENT CORPORATION

Offices: ALBANY • BETHLEHEM, PA. • BIRMINGHAM • BOSTON
CHICAGO • DALLAS • HOUSTON • INDIANAPOLIS • JACKSON, MISS.
KANSAS CITY, MO. • NEW ORLEANS • NEW YORK • NORFOLK
ST. LOUIS • PHILADELPHIA • WASHINGTON, D. C.

LONE STAR CEMENT, WITH ITS SUBSIDIARIES, IS ONE OF THE WORLD'S LARGEST CEMENT PRODUCERS: 15 MODERN MILLS, 27,500,000 BARRELS ANNUAL CAPACITY

JUNE 1950
VOLUME 20 NUMBER 6

CIVIL ENGINEERING

THE MAGAZINE OF ENGINEERED CONSTRUCTION

• In This Issue

Subsidence in Long Beach Harbor Area Requires Special Engineering Construction

Steam Power Plant Protected Against Subsidence Below High Tides . . . *W. L. Chadwick* 17

Ford Avenue Bascule Bridge Jacked Up 7½ Ft in Four Days . . . *R. Howard Annin* 20

Engineers Are Citizens First, Technologists Second . *B. P. Barber* 23

New Lift Bridge Is Cantilevered Over Old Swing Span . . . *W. H. Barnard* 24

Must New Highway Construction Soon Become Overloaded and Obsolete? . . . *Fred Grumm* 28

River and Tide Effects—Lower Colorado River . *L. M. Lawson* 31

Stable Construction Costs for Next Year or Two Predicted . . . *Geo. H. Atkinson* 33

The Turnpike—Pennsylvania's Largest Business Venture . . . *Farley Gannett* 35

New Jersey Builds $220,000,000 Turnpike . . . *Charles M. Noble* 38

Engineer's Shortcut Solves Cubic and Higher Equations and Roots . . . *D. B. Steinman* 41

Program of Toronto Summer Convention . . . 46

• Society News

ASCE Spring Meeting Attracts 1,548 to Los Angeles . . . 50
Military Situation and Unification Explained to Engineers . . . 51
Army Organization Legislation Introduced . . . 51
Board Actions at Los Angeles Abstracted by Secretary . . . 52
Student Chapters Sponsor Nine Regional Spring Conferences . . . 53
From the Nation's Capital . . . 55
Denver Section Is Host to Regional Conference . . . 56
News of Local Sections . . . 58

• News Briefs

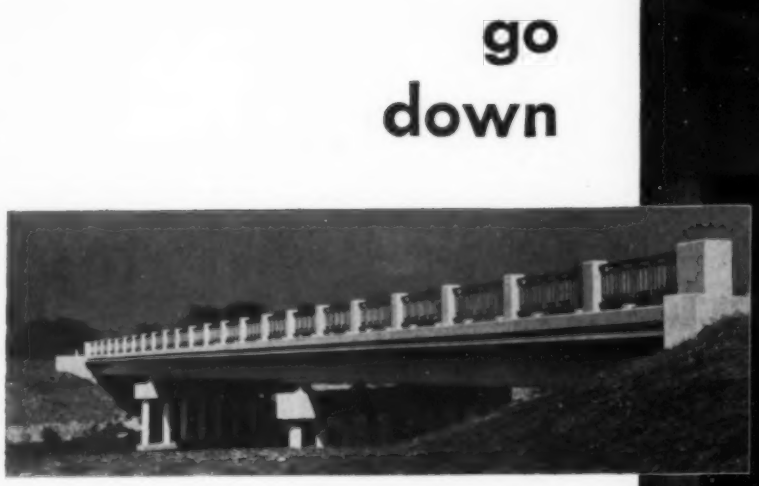
Record-Breaking Construction Activity Reported in April . . . 60
New Mexico Starts Flood Control, Irrigation Works . . . 60
Pollution Control Policy Formed by California Body . . . 62
Toll Method of Financing Highways Called Unsound . . . 62
New Control Plan Speeds Portland Traffic Flow . . . 62
Court Declares Standard Owner-Architect Contract Illegal . . . 64
New York City Names Experts to Study Water Supply . . . 66
N. G. Neare's Column . . . 68

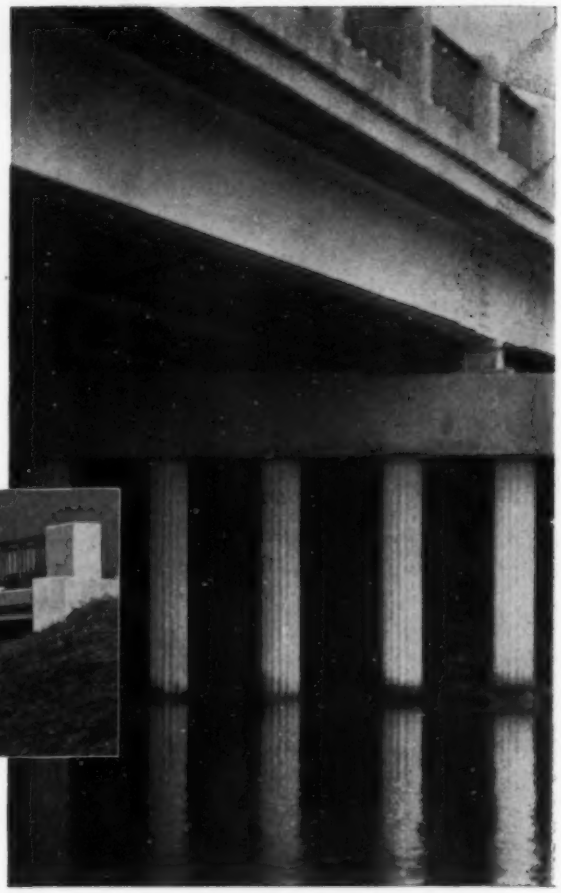
• Departments

Engineers' Notebook . . . 41
The Readers Write . . . 42
N. G. Neare's Column . . . 68
New In Education . . . 72
Deceased . . . 72
Men and Jobs Available . . . 74
News of Engineers . . . 75
New Publications . . . 79
Meetings and Conferences . . . 80
Recent Books . . . 82
Equipment, Materials, and Methods . . . 86
Literature Available . . . 96
Index to Advertisers . . . 104

Proceedings Papers Available as Separates . . . 99

foundation costs go down





WHEN MONOTUBES GO IN!

Bridge on Ohio State Route 161, near Granville, with Monotube steel foundation piles. Another example of the adaptability of Monotubes for any type job.

YOU can check Monotubes, feature by feature—and you'll see how every one helps make important savings.

Take weight, for example. Although Monotubes are inherently strong, they're light in weight and easy to handle. That made it possible on a recent job for the contractor building an overpass to move in with a light truck crane, over a difficult access road, and within 4 hours start driving Monotubes!

And consider Monotube strength. In the job pictured above, single rows of Monotube piles form the piers . . . without longitudinal bracing. *Acting as columns,* these Monotube piles not only provided the necessary strength but saved approximately 90% of the concrete in solid pier construction. In addition, the fluted columns add to the beauty of the structure.

Here are *more* cost-saving, time-saving Monotube advantages. They're easily extendible. There's minimum cut-off waste. And, jobs started with Monotubes can be *completed* with them because they come in a range of lengths, gauges and tapers adaptable to varying soil conditions and different types of structures.

Get the complete story. See how Monotubes can help you design with certainty and save on foundation costs. For information, write to The Union Metal Manufacturing Company, Canton 5, Ohio.

UNION METAL

Monotube Foundation Piles

Subsidence in Long Beach Harbor Area Requires Special Engineering Construction

AN ELLIPTICALLY shaped area in the southwest part of Los Angeles County, in the Terminal Island Long Beach Harbor region—an area about 5 miles long by 3 miles wide, extending partly under the Pacific Ocean—has been sinking at a slowly increasing rate since 1938. Investigators believe that the present rate of $1^1/_2$ ft per year will not increase. The area is occupied by oil wells (oil extraction is blamed in part for the subsidence), by industrial plants and other harbor-front developments. The center of the subsidence bowl has sunk 11 ft so that certain areas today are 6 ft below high tide. Within the depression bowl, surface points are moving toward each other, a 6,000-ft base line having shortened 5 ft.

In this industrially congested area the earth movements manifest themselves by distorting physical structures and threatening them with inundation by the sea and by permanent groundwater. Railroad tracks crawl and buckle; grades of streets either increase or are reversed to such an extent as to require new methods of drainage; some gravity sewer lines have been replaced by pressure mains; water, oil, and gas mains rupture, especially at tees and crosses.

At the Los Angeles meeting of the Society, a full day was devoted to the effects and the probable causes of subsidence in this area and to the remedial construction already undertaken. The engineering solutions for two major manifestations of subsidence are described in the following articles. One involves protection of a water-side steam-electric plant against the sea, the other the raising of a bascule bridge above high tides.

Steam Power Plant Protected Against Subsidence Below High Tides

W. L. CHADWICK, M. ASCE

Manager of Engineering Department, Southern California Edison Co., Los Angeles, Calif.

MANY EFFECTS of the heavy large-area subsidence which is occurring on Terminal Island, Long Beach, may seriously interfere with the use of industrial plants within the area except as they may be protected by remedial construction and repairs. The protective measures carried out at the Long Beach Steam Station of the Southern California Edison Co. are of special interest because they seem to include almost every kind of remedial construction required within the subsidence area.

This station comprises three separate plants with an aggregate generating capacity of 451,000 kw. It is situated in Long Beach, Calif., on the eastern end of Terminal Island, adjacent to the entrance channel to Long Beach Inner Harbor. Plant 1, with 65,000 kw, was built between 1910 and 1915; Plant 2, with 174,000 kw, between 1924 and 1926; and Plant 3, with 212,000 kw, between 1928 and 1930. The station provides about one-quarter of the capacity of the Edison system, supplying the southern terminus of a long 230-kv transmission system, roughly Y-shaped, with the northern terminus in the middle Sierra and the eastern terminus at Hoover Dam.

The station site originally was largely tideland onto which an extensive fill was dredged. Formerly, the entrance channel to Long Beach Inner Harbor east of the station was about 15 ft deep, but in 1926 it was dredged to 40 ft below mean lower low water. Originally also, the station site faced the open sea to the south and the cooling water dis-

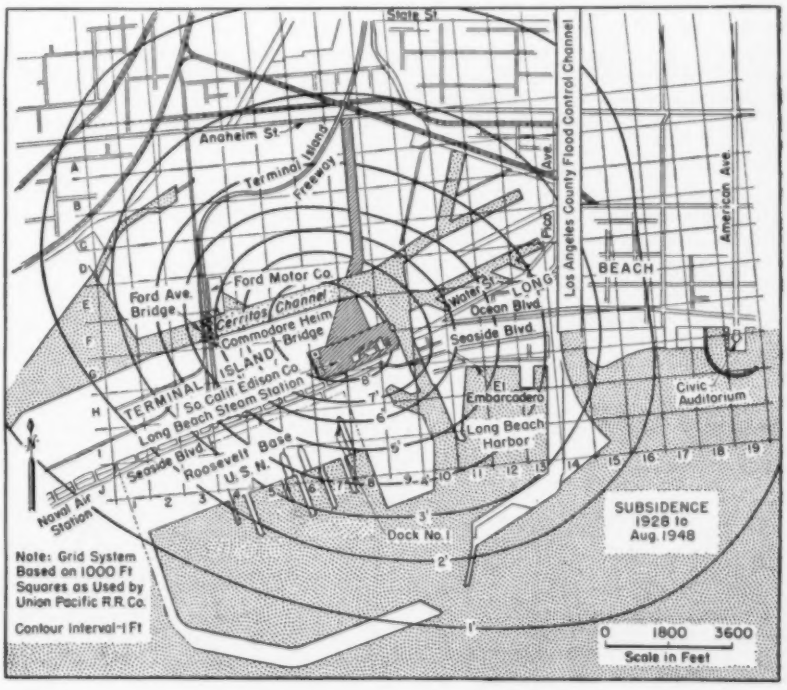


FIG. 1. LONG BEACH STEAM STATION of Southern California Edison Co. of 451,000-kw capacity, has been suffering from subsidence, especially since 1943. Total subsidence to date is about 11 ft.

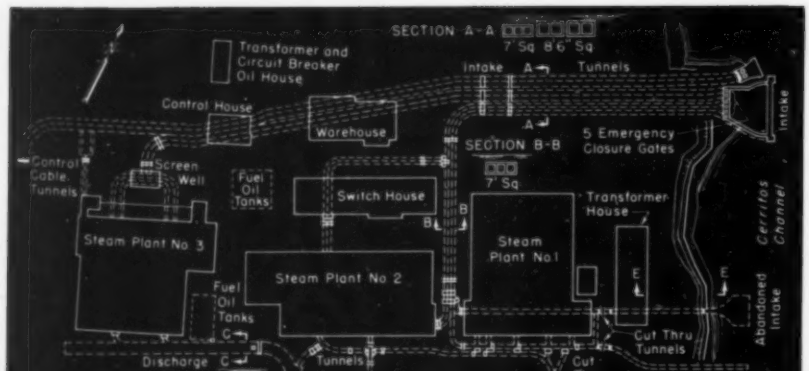


FIG. 2. CONDENSER cooling water—1,500 cfs under full-load conditions—is circulated through system of reinforced concrete tunnels. Dikes, gates, drain pumps, and well points protect against loss of elevation.

charge was to the channel, and later approximately at the breaker line. For the subsequent harbor development and construction of Roosevelt Navy Base, large additional usable frontage was created by dredging. Now a highway 100 ft wide passes along the south side of the station and the Roosevelt base extends southward nearly half a mile to a new sea frontage. The station site with reference to adjacent properties is shown in Fig. 1. Beginning with the Discovery Well in 1937, the Wilmington oilfield has so developed as to surround the station on all sides and includes many wells whipstocked under the channel and out under the outer harbor.

Plant 1 is supported by wall footings and individual spread footings which in turn are founded on individual wooden pile groups. Plant 2 is founded on an 8-ft-thick concrete raft resting on closely spaced wooden piling averaging about 45 ft in length, with the pile heads projecting approximately 6 in. into the concrete raft. The Plant 3 foundation is similar to that of Plant 2 except that certain areas have tremie concrete mats under the main raft, and the raft elevations vary to accommodate variable basement levels of buildings. Pile heads project 6 to 12 in. into the concrete.

Each plant is supplied with condenser cooling water through a system of reinforced concrete tunnels built into the ground from the inner harbor entrance channel to the plants and returning to the outer harbor about 2,000 ft distant. These conduits were built in open trenches on piling and vary in size from 6.5 ft square to 10 ft square and to 22-ft circular. Most of the intake tunnels are built integrally in groups of two or three side by side. Under full-load conditions, about 1,500 cfs of salt water is pumped through these systems. The general arrangement of these conduits is given in Fig. 2. Gate wells, stop-log gates, and interconnections provide means of sectionalizing individual intake tunnels and taking them out of service individually for clearing marine growths without shutting down an entire plant. The main discharge conduit serves all three plants and detailed sectionalizing of it is not practicable. This conduit, however, does not require periodic cleaning.

The company's first concern over the large-area subsidence arose in 1940 and 1941 when the excavation for the main drydock at Roosevelt Navy Base was unwatered by deep wells penetrating an underlying aquifer and reducing the hydrostatic pressure under the overlying sediments by from 40 to 50 ft. Concurrent subsidences occurred of from 0.1 to 0.7 ft. (See "Construction Procedure" by Donald R. Warren; "Soil Test Procedures" by Frederick J. Converse; "Protection of Adjacent Properties" by Charles T. Leeds, in CIVIL ENGINEERING, August 1944.) Upon cessation of drydock pumping and restoration of the aquifer pressure, some recovery of elevations occurred, amounting to less than 0.2 ft.

Subsidence Shortens and Fractures Conduits

Beginning about 1943, evidences of further subsidence were observed, amounting to several times that experienced during the drydock unwatering. The total observed subsidence up to May 1950 approaches 11 ft. (See "Long Beach Naval Shipyard Endangered by Subsidence," by Lewis C. Coxe, CIVIL ENGINEERING, November 1949.)

Beginning in 1947, fractures were observed in some of the underground conduits serving the station. These fractures indicated heavy horizontal forces in the earth surrounding the conduits. T. M. Leps offered the explanation that these forces could be likened to the compression occurring in the upper fibers of a deep, heavy beam uniformly loaded. Ground shortenings observed in the vicinity of the station average about 0.2 ft per 100 ft. The shortening is practically the same whether measured east-west or north-south. There is evidence that the center of subsidence is shifting slightly.

Fractures in underground conduits occur at discontinuities such as (1) gate wells where the conduit is imperfect as a column; (2) bends where concrete will not carry in shear the forces it can carry as a column; and (3) wye connections where combined shears and compression tend to break the wye and the connecting conduit at the root.

Dikes Built and Pumps Installed

The protective works completed or under construction fall into two principal classes: (1) Protection against loss of elevation and (2) protection against earth pressure. The first class consists of two groups—stops against the sea, and drainage. The most obvious sea stop is, of course, diking. An earthfill dike has been constructed along the channel side of the property using a rolled fill with clay core designed to resist 15 ft of subsidence but capable of being raised higher if required. A section through this dike is shown in Fig. 2. A filter along the inboard toe and a permanent well-point system control any adverse saturation gradient through the dam. The integrity of every one of these dikes is of the utmost importance to each property within the subsidence area. Construction of secondary dikes

around the individual station buildings also is contemplated.

Other stops are the raising of sides around all openings such as gate wells and drainage openings, to avoid spilling at high tide. This work has been completed to offset 15 ft of subsidence. It is planned to install emergency gates at the seaward end of all conduits to permit prompt closing off of any flood should a pipeline rupture in the plant enclosure. These gates have been designed; they will be slide gates of somewhat standard design built with scraper leading edges to clear marine growths from the gate slots as the gates descend. Each gate will be controlled by a separate motor-driven gear-operated hoist. Closure will be manually actuated.

Calculations have been made for the bursting strength of all cooling-water conduits when filled with water on one side of a common wall and unwatered on the other, also for the bursting resistance of the whole system under these conditions. Some reinforcement was indicated and has been completed for 15 ft of subsidence. A similar study was necessary for all sewer and drain lines, and all salt-water piping within the plants, including valves, pump casings and condenser-water boxes.

The second group of works for protection against loss of elevation is composed of drainage facilities. These come under three main heads: (1) Means of holding the groundwater down to avoid surface ponding and the effects of increasing buoyancy on buildings; (2) means of disposal for all drainage from plant equipment and facilities and all sewage; and (3) means of disposal for any flooding which might occur either from conduit rupture or storm effects. The first group has been quite satisfactorily handled by a permanent well-point system arranged in the form of a long rectangle surrounding all main facilities and also draining the dike toe. This system is in continuous operation on a float control, set to hold groundwater to 8 ft below the surface. The system is currently handling about 350 gpm, which is about 10 percent of its design capacity.

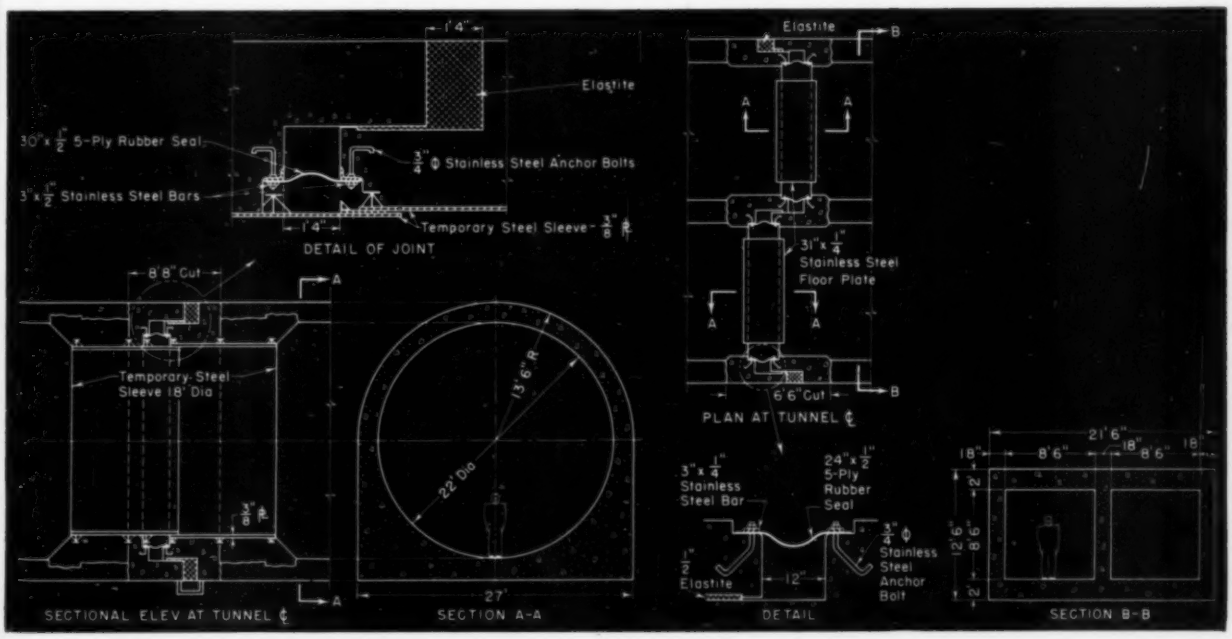
All Drainage Must Be Pumped

Gravity disposal no longer being possible, all drainage within the plant and all sewage is pumped from sumps and tanks by float-controlled pumps. Altogether 52 separate installations are in service. To dispose of emergency drainage, a system of collecting gutters, collecting channels, a large sump and low-head pumps is being provided. The system is designed to handle an inflow of 100 cfs from any part of the plant site.

By far the most troublesome effect of the subsidence is the ground pressure occasioned by the shortening. It is unrelenting and ever-present. So far, its worst effects have been on long, buried structures. Reduction of the results of these forces has been obtained by cutting the longer lengths and inserting compression joints, each built to absorb as much as a foot of shortening. Further reduction has been accomplished by isolating long lines from wye laterals, from bends, and from certain gate wells, also using compression joints. The construction of these joints was complicated by the necessity of keeping the plant in continuous operation, by the considerable depth of the conduits below sea level, and by the existence of many plant structures both above and below ground.

Construction of each joint required complete severance of the affected conduit or group of conduits. It was realized that this severance would probably result in an abrupt strain release, probably a "bump." To permit continuous use of the conduits during these cutting operations, short outages were taken on individual tunnels while temporary steel sleeves provided with packed center slip-joints or glands, were built into the conduits to be severed. Each sleeve was made as near the same size as the enclosing conduit as the need for working room around the gland would permit. The ends of the sleeves were fastened to the conduit by concreted transitions.

FIG. 3. SUBSIDENCE is accompanied by linear shortening of ground in which long conduits and tunnels are buried. Shortening averages 3 in. per 100 ft. Conduits are cut into shorter lengths, and special compression joints built in each to absorb up to a foot of shortening.



As soon as the sleeves were complete, cutting of the conduit was started, working through the top first, then down all sides at once, using long holes in an effort to weaken all the walls at about the same rate and hence avoid possible long wall-spalls or unequal stress adjustment. As soon as the walls were cut to the floor, drilling and cutting of the floor followed. In each case while cutting the floor, an abrupt "bump" occurred, causing closures varying from 0.02 to 0.20 ft. Some of these bumps caused the switchboard instruments in nearby control rooms to be momentarily but sharply affected. Each joint consists of a half lap built into the concrete and a water-stop membrane consisting of five-ply rubber belting securely bolted to the concrete across the joint by stainless-steel clamp rings held by close-set stainless-steel bolts.

Several different joint designs were considered. The combination of corrosive water, space limitations, other structure interferences, and the need for minimum interruption to plant operation imposed difficult design restrictions. The best solution found was the joint used. Although only a small amount of lateral movement can be taken in this joint, each joint is located in the system so as to minimize the transmission of lateral forces. Details of two of the joints as built are shown in Fig. 3. In all, 30 joints have been constructed. Some have been in operation a full year with satisfactory service.

Joint closures have continued steadily since their completion, the greatest being between the two longest sections of conduit and totaling 0.5 ft at present. Joint construction was carried out through heavily timbered open excavations with well-point unwatering, although some of the excavations had to go down to 34 ft below the then mean tide. To reduce plant outage to a minimum, the top of the 22-ft-dia main discharge tunnel was cut through in two places and an 18-ft-dia steel slip-sleeve was set and concreted in place in each location. The tunnel was returned to service in nine days. With these sleeves in place, completion of the joints proceeded while the plants carried their full normal loads.

Earth pressure and shortening also affects both buried and exposed gas, oil, water and sewer lines. Each is being treated like the larger cooling-water conduits by the use of flexible joints protected by concrete boxes. Location of these joints at the most desirable point is not often possible because of interference from other structures.

The concrete envelopes of buried electrical conduits and cable tunnels connecting the main buildings also are affected by earth pressure, which pushes these laterals through building walls. These effects have been offset by constructing slip planes in the walls so that the envelopes can protrude without harm.

To date the gradient across the subsidence depression has been flat enough so that no serious differentials have occurred in the settlement of buildings or machine foundations. Some small correction of misalignment which is believed to be the result of subsidence has been made at each overhaul period, principally by releveling and planing of bearing pedestals.

Considerable study and some exploration have been carried out on the effects of earth pressure on piling and subsurface walls. Piles uncovered and cut to observe the strains so far have shown no serious condition. Some strain exists but it is still well within the strength of the foundations. At some time in the future, a relief trench may be necessary around the larger structures. From observations to date, no damage to subsurface walls is expected unless subsidence should reach several feet more than at present, in which event relief construction is practicable and would be provided.

Estimates on probable subsidence as an aid in designing offsetting works, have been most difficult to obtain, but by continual vigilance and prompt repair, plus the construction of protective works in advance of flooding or overstressing, no involuntary interruption to the Long Beach Station operation has so far occurred. The one nine-day outage noted was planned in advance and other offsetting capacity was provided. Even though it may not be possible to definitely predict the amount of ultimate subsidence, it is expected that continued advance construction of protective works and relief measures as subsidence proceeds will assure the continued availability of the station for public service.

Ford Avenue Bascule Bridge Jacked Up 7½ Ft in Four Days

Subsidence Caused Tops of Piers and Bridge Rockers to Be Awash at High Tide

R. HOWARD ANNIN, M. ASCE
Consulting Engineer, Los Angeles, Calif.

LONG CONTINUED general subsidence of Terminal Island and the adjacent area, (CIVIL ENGINEERING, November 1949, page 44) has so seriously affected many of the facilities and structures in the vicinity that corrective steps must be taken. One of the important structures affected is the Ford Avenue Bridge which spans Cerritos Channel, joining Terminal Island with the mainland and providing the only railroad access to the island.

The Ford Avenue Bridge, a Strauss trunnion bascule built in 1922, consists of two approach spans of timber construction, two steel counterweight tower spans each 50 ft in length resting on concrete piers, and a 220-ft clear span across the channel formed by the two 110-ft leaves of the bascule bridge meeting at mid channel.

The area adjacent to the bridge had settled approximately 5 ft at the time this work commenced so that the tops of the piers and the rocker nests on which the bridge rested were under water at high tide. In addition to the vertical movement resulting from the settlement, horizontal movement had also occurred which diminished the distance across the channel and caused the movable main span to jam and lock so that the leaves could not be opened for the passing of ships through Cerritos Channel. Because of this horizontal movement, the main span was found to be acting as an arch, the thrust being taken by the approach spans and piers. Even with the railroad live loads on the bridge, no tension

occurred across the center lock in the bottom chord. Also, the center span was found to be slightly out of line.

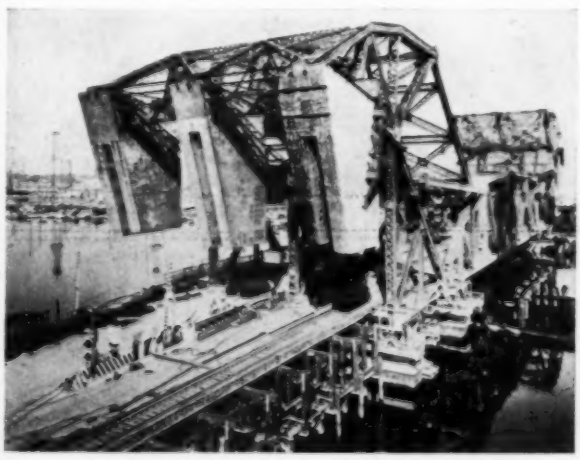
Because of the cost that would be involved in rebuilding this bridge, the Harbor Commission of Long Beach decided that the economic procedure would be to raise the present structure. Raising of the approach spans, of timber on wood piles, involved no serious engineering problem. The steel structure in the center, however, presented more difficulties. The steel spans and counterweights, totaling more than 5,000 tons in weight, are carried on four concrete piers, two on each side of the channel. The loads of the bridge are carried by three short steel posts on each pier, or a total of 12 posts. The loads on the individual posts vary greatly. The three posts on each pier are connected across the bridge by deep plate floor girders rigidly attached immediately above the base plates, thus providing a very small clearance between them and the top of the concrete piers. Neither the floor girders nor any other members at the posts were of sufficient strength to act as jacking points.

In addition to the practical difficulties connected with this project, economic considerations permitted but five days during which rail traffic to Terminal Island could be completely shut off. Thus the bridge had to be kept open to rail traffic continuously except for a single five-day period and a limited number of 8-hour periods.

As jacking seemed the only feasible means of raising the steel spans, the first need was to provide at each post supports which would be sufficiently strong to carry the maximum load on the post, and at the same time would not reduce the already exceedingly small clearances above the piers. This aim was accomplished by reinforcing the floor-girder connections to the posts and erecting steel brackets on the north and south posts so that jacks could be installed on both sides of each post. Because of the small clearances and the large size of the cabin plates, especially those at the trunnion supports, it was difficult and complicated to provide sufficient jacking connections. Nearly every post required an individual design, using every available point for additional rivets or other connections. Also, this work had to be performed with only very short interruptions to rail traffic.

FORD AVENUE BASCULE Bridge (foreground), of 220-ft span, was locked shut by general subsidence in Long Beach Harbor area. Jacking raised rockers above high tides and permitted operation of span. In background is Commodore Heim vertical-lift bridge.

On account of the clearances available and the limited number of points capable of taking jacking loads, only two jacks were used at each post, or 24 in all. Since the maximum post load was over 600 tons, some of the jacks had to have a capacity of not less than 300 tons. Therefore jacks of 350-ton capacity were selected to provide some surplus. As the transverse floor girders over each pier are very deep and rigidly connected to the posts by rivets, the relative elevation of each of the three posts on each pier was important if excessive stresses were to be avoided. Although no accurate measure of the rigidity of the end connections of the floor girders could be made, computations indicated that the maximum advisable deviation in the elevation of the three posts from a straight line would be around $\frac{1}{4}$ in. It was decided that the easiest way to hold the deviation within this tolerance was to make all the jacks alike so that their travel could be coordinated by controlling the volume of oil used regardless of the load at the post.

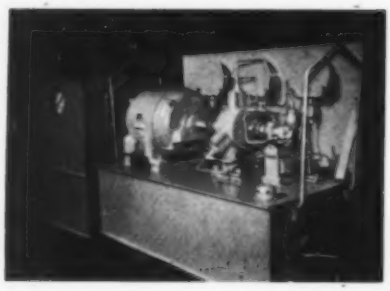


SIX JACKS on each of four piers simultaneously raise 5,000-ton bascule bridge over Cerritos Channel total of 7½ ft in fifteen 6-in. lifts. Bridge was built in 1922.

It was not feasible to control the volume flow of oil to each jack by means of needle valves when such high unit pressures were used. The flow through the lines proved to be so small that needle valves were extremely inaccurate and susceptible to plugging by very small particles. Instead all six jacks at each pier were connected to a single pump having three cylinders radially mounted on a common shaft. The three cylinders were similar but independent. Each cylinder supplied the same quantity of oil regardless of the pressure and was connected directly to the two jacks on the same post. Theoretically, all the posts on any one pier should rise uniformly; however, by means of bypasses and valves, any jack could be speeded up or delayed whenever necessary. The two jacks at any one post were fed by a single line so that the total load at the post would be equally divided between the two jacks, and consequently any eccentric stress in the post or an overload on the connections at the post would be eliminated.

Whole Bridge Raised with Leaves Lowered

The entire bridge was raised in one operation with the leaves of the center span locked in closed position. This procedure reduced the danger of getting the bridge out of line during the raising operation. Variation in the elevation of the bridge at any pier in relation to that at any other pier was not troublesome as there were no rigid connections between



SINGLE THREE-CYLINDER OIL PUMP, operating at 10,000 psi, is connected to six jacks on one pier, each pump cylinder being connected to the pair of jacks at one bearing post.

the various spans of the bridge as long as the racks and pinions for operation of the center spans were free to move at will. At times the jacking on one pier might advance several inches ahead of that on another pier, or on all the other piers, without any detrimental effect.

The jacks were made for a hydraulic pressure of 10,000 psi to keep them as small as practicable. The travel of the jacks was limited to $8\frac{1}{2}$ in. by the clearances available, and even with this small travel, it was necessary to cut the top of the piers in some instances. The usable travel of the jacks was fixed at approximately 6 in.

Shims and Grillages Follow Jacking Closely

Three independent grillages were used at each post, one for each of the two jacks and one under the post base-plate. To expedite the placing of the grillages, the I-beams were preassembled into nests of four or five and welded together with stiffeners into pads 6 in. high. The weight of these nests was such that they could be handled by two men. Each jack was placed in a heavy steel box two sides of which were capped with a heavy bearing plate 6 in. wide to be used as a base for shimming. As the jack raised the bridge, $\frac{1}{4}$-in. and $\frac{1}{2}$-in. shim plates were continually added to the bases on the box so that at no time was there a space of more than $\frac{5}{8}$ in. between the top of the shims and the bearing plates on the bridge. If a jack failed, the bridge could not drop more than this distance.

Shim plates on all bearings of the six jacks on any pier were installed simultaneously so that an even bearing would be available should the bridge drop. After the full 6-in. lift of the jacks was reached, the jack grillages were tightly shimmed over the boxes and a grillage made up of the 6-in. I-beams was inserted under the main post bearing. After this bearing had been tightly shimmed on the grillage, the load of the bridge was again transferred to the post bearing. The shims over the jacking boxes were removed, and the jacks and jacking boxes were raised

HEAVY STEEL BOX houses jack and forms base for shim plates inserted as bridge is raised.

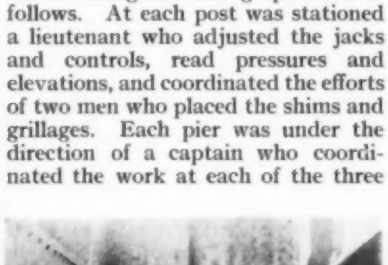
up by retracting the jacks with hydraulic pressure. Grillage nests were then added under the jacking boxes and the same procedure was repeated.

Since this bridge is in an active earthquake zone, precautions were taken to avoid damage from this cause. The raising was divided into three stages of approximately 30 in. each—$7\frac{1}{2}$ ft in all. During the day the bridge was raised approximately 30 in. At night, while the bridge rested on all the grillages, the top of each pier was concreted to just below the top of the grillages. The following morning the raising process was resumed for another 30 in. and the concreting repeated the following night. This procedure was followed in practice except for the first 30-in. lift, for which two days were required.

The extra day on the first lift was needed to familiarize the men with their work and to permit removal of the rocker nests and bearing plates from under the sole plates of the bridge. A contributing factor was the problem of leakage at the hydraulic pumps. In fact throughout the raising operation the leakage of hydraulic valves and packings caused more trouble and delay than any other phase of the work. It is believed that, until more effective packings and valves are developed, a lower working pressure for the hydraulic system should be used. Probably the maximum pressure should be limited to not over 6,000 psi instead of the 10,000 psi used in this instance.

As the load of the bridge was at all times resting on the grillages, which in turn rested directly on the original pier surfaces, the work of raising could be carried on before the concrete had gained high strength. By this procedure the unsupported height of the grillages was kept to a minimum, as the concrete reinforced them against lateral movement.

The contractors organized their forces during the raising operation as follows. At each post was stationed a lieutenant who adjusted the jacks and controls, read pressures and elevations, and coordinated the efforts of two men who placed the shims and grillages. Each pier was under the direction of a captain who coordinated the work at each of the three



I-BEAM GRILLAGE is inserted under bridge bearing post after each 6-in. lift. Load is then transferred to post, shims are removed, jacking boxes and jacks are raised onto jacking grillage, and jacking is resumed.

posts and checked relative progress, reporting such progress by phone to the pump operator and the supervisor at each end of the bridge. Elevations of the bridge at each post were also checked independently on the bridge deck by engineers to insure proper coordination and even raising.

Using the methods outlined, raising was completed in a little over four days after the first lift began. Train service was resumed on schedule while the bridge rested on the temporary grillages and shims. New or reconditioned rocker bases, which had been removed at the start of the jacking operation and sent to the machine shop for reconditioning, were installed easily as they became available with no interruption to rail traffic.

No indication of any damage or serious strain in bridge or connections could be found anywhere. Much to our satisfaction, the bridge automatically realigned itself during raising operations so that no adjustment was necessary after final elevations were reached.

At the request of the Long Beach Harbor engineers, the bridge was left in such condition that the jacks could easily be reinstalled and the bridge again raised, if that became necessary, with a minimum of effort and of cost.

Engineers Are Citizens First, Technologists Second

B. P. BARBER, M. ASCE
President, Barber, Keels & Associates, Inc., Columbia, S.C.

THERE IS a current belief in academic and professional circles that engineers are concerned only with the technical aspects of their profession. Engineers are continually being criticized, even by their own members, for not being active in political, social and religious affairs. To some extent at least, this lack of interest in human affairs must be typical of the engineer, otherwise there would not be such a clamor about it on all sides.

In defense of the engineer it must be said that usually his work is such that he can to a large extent remove the human element as a factor in the solution of his problem. Designing a transmission line or planning the strength of a bridge can be accomplished with little worry about the human element. Thus the average engineer does not feel the need for social or political activity as an adjunct to his business as keenly as do other professionals.

In recent years, however, certain engineers with a sense of moral responsibility for the use to which their labors are put have come to realize that only through active participation in the affairs of men can they have any control over how their talents are utilized. They have seen machines built for humanity used for human destruction; they have seen squandering of public funds due to improper or complete lack of engineering analysis; and they have seen legislation detrimental to the health and welfare of the public passed by legislators not familiar with the engineering facts.

The main cry for engineering participation in social and political affairs has centered in organizations composed of registered professional engineers. These engineers, who have been recognized by the state as particularly qualified to serve in the community interest, through the efforts of their respective societies, have continually worked for needed improvements in the lot of all engineers.

It can certainly be said that the average engineer is concerned with the spiritual values of life and does something about it. His profession may emphasize the material side of life but his sense of values goes deeper and rests on a belief in God and consequently in human dignity. It is little wonder, then, that he is critical of himself for not serving his fellow men. Further, since engineers holding positions of responsibility in the engineering field also exert extensive leadership in their local churches, it would appear that the engineer is far from the skeptical, aloof individual sometimes pictured.

Where Is Specialization Leading Us?

We have been caught up in this century in a whirlwind of new knowledge and its application, and it has left us breathless and trembling. With the atomic bomb, we were suddenly shocked into the realization that our human capacity for specialization had gone ahead of our human capacity for thoughtful adjustment. Hiroshima was, in a sense, the final and staggering piece of evidence to prove, if more proof were needed, that the engineer of today stands squarely in the center of the stage.

Engineers, as the foremost professional men of the day, must leave off being mere engineers and lead the way toward a balanced and integrated society. Engineers are bound henceforth to understand not only the technological progress which they are achieving, but also the kind of society which supports that progress and, in turn, is carried on its shoulders. The question is not what are we doing as bridge builders and physical scientists, but what are we doing as moral scientists and social technologists?

As the engineer considers these questions of professional stewardship, he must admit that it is no longer possible for him to confine his efforts to engineering. The peculiar forces with which he is dealing today will make it extremely difficult for him to limit himself, in this modern world, to technical matters. He has come too far, he and those who have preceded him, and he has powerfully affected and shaped the lives and destinies of too many millions of people to deny his responsibility now.

In his preoccupation with the slide rule, the engineer cannot safely leave to others the larger job of defending the way of life made possible by his own contributions. He has no right to delegate the duties of citizenship simply because he has a test to run or a specification to write. He has no right to turn away from such problems as education, taxation, government reorganization, national security, civil rights, labor and management simply because they may involve him in controversy and take his time. It is quite true, of course, that no man today has the right to turn his back on these things, but the professional man has a particular obligation to understand and to act.

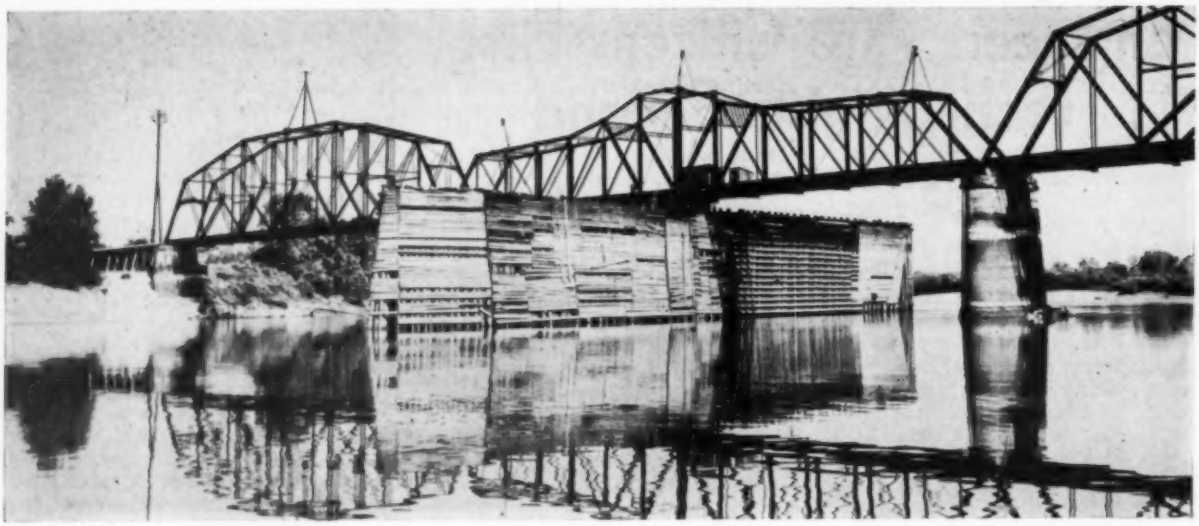
The day is past when the professional man can delegate his understanding and his action, in a sphere not specifically his own, to some selected advocate, or else neglect it altogether. When Communism jumps out of every headline and from around every familiar corner, the situation of even the average man becomes a little uncomfortable, and that of the professional man may be particularly difficult. Here again there is a great temptation for the true specialist, such as the engineer and the scientist, to withdraw into the respectable and protective cocoon of his immediate task and leave to others the defense of the nation. The true professional man, if he values his integrity, will not compromise on such an issue. He cannot if he wants to keep his self-respect.

This country stands to gain much from the contribution of engineers. If the engineers decided to cease work tomorrow the whole country would be paralyzed. The great turbines would stop, the water so necessary for life, the disposal of waste—would all cease to be taken for granted. Transportation would be reduced to foot locomotion. A look around one's own room shows that nearly everything was designed on a drafting board.

Engineers have been consultants, not leaders, yet they can do more for us tomorrow than any other group in the whole country. In the present state of the world, the engineer can no longer be content with his post at the drafting board.

True, the nature of the engineering profession demands the traditional sureness and caution of science. The engineer can still retain his caution, but, from his knowledge he can give us light; he can build up public pressure for the important things he knows should be, and can be done. By talking about these things now the engineer will stand a better chance of realizing his dreams.

This article is based on Mr. Barber's paper in "The South Carolina Engineer" (Vol. 1, No. 7).



OLD TOMBIGBEE RIVER BRIDGE (above) at Jackson, Ala., with center swing span and two side spans, was first opened to traffic in July 1888. Substitution of lift span was required by Corps of Engineers to provide greater clearance for navigation. New structure, shown in other photographs, was built practically on center line of old bridge. Although construction took two years, navigation suffered no greater interference than that caused by old center pier, and crossing was out of service only about 30 hours.

REMOVAL OF OLD SWING SPAN follows completion of lift span. Members of old swing span were handled by hoists on lift span and lowered to barges in river. When final section of old span had been removed, lift span was lowered into place. Tracks were laid on new span as it was constructed. Old piers and fenders will be removed and new fenders built under another contract.

New Lift Bridge Is Cantilevered Over Old Swing Span

W. H. BARNARD

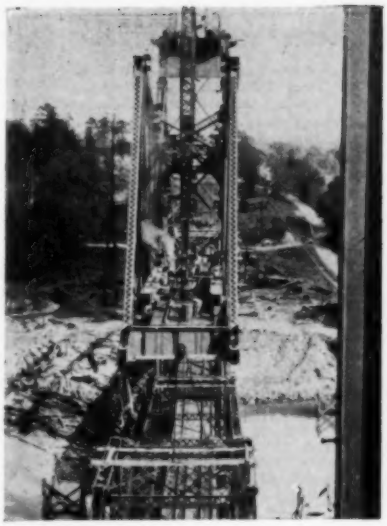
Bridge Engineer, Southern Railway System, Washington, D.C.

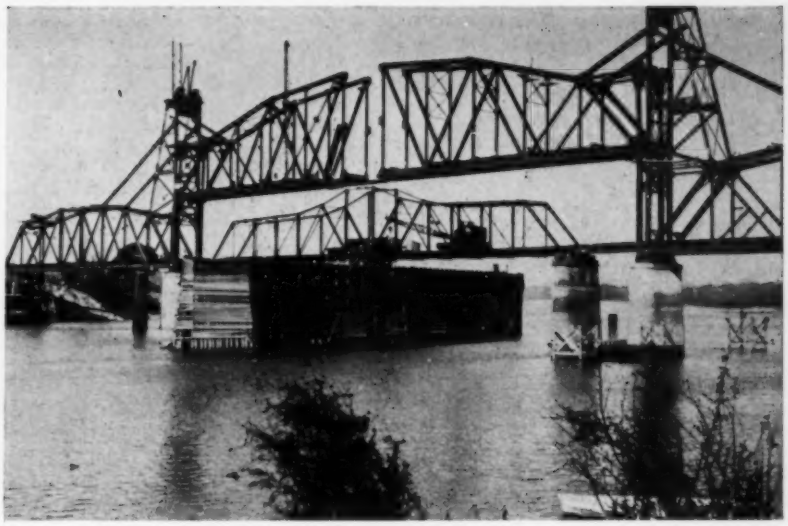
BUILDING a vertical-lift railroad bridge on the exact site of, and without first removing, the old swing span was the job successfully completed by Southern Railway engineers at Jackson, Ala., in February of this year. Although the construction of the new bridge took two years, the track crossing the Tombigbee River was out of service only some 30 hours and river traffic beneath the bridge was not impeded any more than it had been by the old swing span. Design features and construction techniques mingled ingenuity with standard methods.

TO IMPROVE navigation on the Tombigbee River, the Southern Railway was required by the Corps of Engineers to rebuild the Tombigbee River Bridge at Jackson, Ala. In place of the old swing-span, the railroad built a vertical-lift structure to meet the 300-ft horizontal clearance and the 52-ft vertical clearance required. The new structure was built over and under the old bridge in such a way that the single track crossing the structure was out of service only about 30 hours during the two-year construction period.

Plans for the new vertical-lift bridge provided three single-track, through-truss spans arranged symmetrically, with the center of the middle span at the center of the old pivot pier. The trusses are of the Warren type with curved upper chords. The lift span is about 335 ft long, and the adjacent tower spans are about 233 ft long, one on each side of the lift span. Clearance through the bridge for railway traffic is 22 ft vertically and 15 ft horizontally. For river traffic the lift span provides a horizontal clearance of 300 ft between fenders, and a vertical clearance in raised position of 52 ft above ordinary high water. In lowered position there is a 7-ft clearance above ordinary high water.

The vertical lift span, the tower spans, and the towers are fully riveted. Silicon steel was used in the trusses (except verticals), bottom laterals, and front columns of towers. Its use, especially in the lift span, resulted in marked economy because of reduction of the load to be lifted.





VIEW FROM TOWER of lift span (top left) shows old through truss and tracks in service below while construction proceeds on cantilevered section above. New span has clearance above high water of 52 ft when raised and 7 ft when lowered.

CANTILEVERED SECTIONS of center span approach each other (top right) while swing span beneath remains in service. Inclined members temporarily added to towers tie them to approaches during construction of lift span. Temporary bents support each end of lift span until counterweights are added.

SEVEN-THOUSAND-TON diesel-powered train crosses new bridge at official opening ceremonies in February 1950. New structure, designed for Cooper's E-65 loading, has carrying capacity 2½ times that of old.

The dead load of the lift span is carried at its four corners by wire ropes which pass over sheaves on the top of the towers and are connected to counterweights of weighted concrete in steel boxes. Because the lift is low, there was no economy in using balance chains on the counterweights. Replacement of counterweight cables can be accomplished at any time by jacking up the counterweights on temporary beams supported on girders built into the longitudinal bracing of the towers. Rope connections are made in such a way that any single rope can be replaced without removing any other rope.

The lift span is raised or lowered by means of operating ropes wound on drums geared to machinery at the center of the lift span. These operating ropes pass outside the trusses, up to the top chords at about the third points, and thence to deflector sheaves at the four corners of the lift span. From there they pass to connections at the top and bottom of the towers. Hand-operated drum devices, with worm gears, are provided to take up slack and adjust rope tension to maintain a level span during operation.

Guides provided at both top and bottom chords, at the four corners of the lift span, engage guide angles on the tower columns to maintain the span in proper longitudinal and transverse position during movement. Centering castings, at the center of the end floorbeams of the lift span and on the piers, center the span and track transversely as the span is lowered to its seat. Rail locks are provided in conjunction with the special rail joints at the ends of the lift span. All operating machinery, rail locks, and controls are interlocked with the train signal system.

A stairway provides access to the combined machinery and operator's house at the center of the lift span. Walks, platforms, and ladders are provided for easy access to all machinery parts not in the house and to navigation lights and aerial beacons.

Each tower is built with the two vertical front columns supported on shoes common with the tower spans, and the two inclined rear columns supported on the top chords of the tower span. There is bracing in all four faces of each tower. Sheave hoods are provided to cover the counterweight cables where they lie on the main sheaves.

The new piers are of reinforced concrete supported on wide-flange steel bearing piles driven to the bedrock underlying the river. The fender protecting the north pier and the dolphin protecting the south pier will be built of creosoted lumber and piles with tops above ordinary high water.

The entire structure is designed in accordance with the 1947 specifications of the American Railway Engineering Association, for Cooper's E-65 loading—nearly 2½ times stronger than the old bridge in terms of carrying capacity. It can carry any locomotive operating on the Southern

FALSEWORK SUPPORTS approach span while new truss is being erected. Train service was not interrupted during this replacement work, as falsework carried loads during entire operation.

Railway and the heaviest railway cars without using spacers. The 6-mph speed limit formerly in effect will be removed when the new bridge is fully completed.

While the plans were in the process of approval, negotiations were being carried on between the government and the railway to determine the division of cost under the Truman-Hobbs Act. The actual dollar distribution is to be based on contract prices but the principles to be used in dividing the cost were arrived at in a series of conferences between representatives of the Corps of Engineers and the office of the Chief Engineer of the Southern Railway.

The plans were approved by the government on April 13, 1948. Bids were opened on May 18, and work was started at the site on July 12, 1948.

The Truman-Hobbs Act, which calls for the government to pay part of the replacement costs of bridges which it orders altered to improve navigation conditions, requires that the railway company guarantee the cost of the project to the government. On May 20, 1948, the railway company submitted to the government a recommendation of award of contracts, together with the required guarantee of cost. Low bidders to whom contracts were recommended to be awarded, and approximate amount of bids are listed in Table I.

Construction had to be scheduled very carefully because of the extreme high water encountered on the Tombigbee River. The schedule called for the construction of the two channel piers during the summer and fall of 1948, construction of the end piers and erection of superstructure during the summer and fall of 1949, and removal of the old piers and fender and construction of the new fender during the summer and fall of 1950. However, the government's delay in approving the contract award prevented the Hardaway Contracting Co. from going to work as soon as intended, delaying the pier schedule.

The two new channel piers were constructed by driving steel sheetpile cofferdams in the river. The river bottom was dredged inside the cofferdams and steel bearing piles driven to rock. The cofferdams were then sealed under water, pumped out, and pier shafts constructed in the dry.

One noteworthy incident during the construction of the north pier occurred when, in driving the sheetpiling, soft rock was encountered which hindered the driving. In order to expedite his work the contractor excavated deeper than was contemplated by the specifications. As this pier was only 40 ft from the old pier, which rested on clay at the bottom of the river, this excavation permitted a flow of bearing material from under the old pier and it began to settle. Settlement was stopped by dumping several barge loads of sand into the excavation and work on the north pier continued without further incident. Total settlement was about $3\frac{1}{2}$ in.

Construction of the south pier proceeded satisfactorily until December 1948, when the rising river made it necessary to suspend operations for the winter. Work on the south channel pier was resumed in June 1949 and was completed in July 1949.

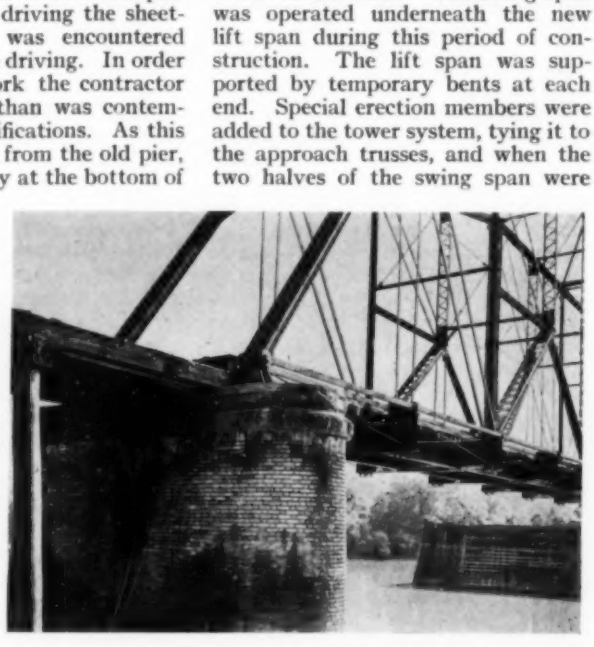
Erection of steelwork was begun in June 1949 by placing the old approach trusses on falsework and dismantling them. Temporary beams were placed between the old rest piers and the new piers. The new approach or tower spans were then constructed on falsework and the towers erected.

The lift span was cantilevered out over the old swing span from the tower on each side. The swing span was operated underneath the new lift span during this period of construction. The lift span was supported by temporary bents at each end. Special erection members were added to the tower system, tying it to the approach trusses, and when the two halves of the swing span were

TABLE I. LOW BIDDERS AND BIDS

Construction of two new channel piers, Hardaway Contracting Co., Columbus, Ga.	$250,000
Fabrication of steel superstructure, Virginia Bridge Co., Roanoke, Va.	530,000
Erection of steel superstructure, Virginia Bridge Co.	400,000
Reconstruction of end piers, Ernest Construction Co., Mobile, Ala.	110,000
Removal of old piers and fenders and construction of new fenders, Ernest Construction Co.	200,000

Total cost of the project was guaranteed to be not more than $1,970,000 (including contingencies and work done by the railway company), of which $1,212,000 would be paid by the government and $758,000 by the railway



BRICK PIERS of old bridge stood on timber caissons surmounted by concrete-filled timber cribs. Bricks, still in excellent condition, came from abandoned warehouses in Mobile; they were originally made in England about 125 years ago and brought to this country as ballast. Reinforced concrete piers of new bridge are supported on wide-flange steel piles driven to bedrock.

cantilevered out to the middle and joined together, the temporary tower members were removed. Cables and operating machinery were installed and the counterweights poured. The lift span was then completed and the track installed. The temporary bents were removed, the lift span fastened temporarily to the towers, and the old span swung from the lift span. The old swing span was burned apart, dismantled with hoists located on the lift span, and lowered to barges.

Core drillings were made at the site of the river piers in the fall of 1947. It had been intended to carry the piers to rock by means of pneumatic caissons but the rock revealed by the cores proved to be of such a nature that steel bearing piles seemed more economical. During this core drilling, artesian sulfur water was struck, which caused a decrease in the flow of water in the well of the bridgetender $\frac{1}{4}$ mile away. Salt water was also encountered during drilling.

One interesting feature of construction was the rebuilding of the old end piers without interference with traffic. Provision was made for carrying one end of each approach span on a temporary pier one panel removed from the permanent pier. A beam span was fastened to the end floorbeam of the approach truss, spanning the end pier, and thus giving a clear working space in which to demolish the old end piers and build the new ones.

The north end pier was built in the dry and it was contemplated that the south pier would be similarly built, but excavation proved it necessary to seal the south pier under water.

The river is eroding the south bank rather rapidly and may some day run behind the south end pier of the bridge. Provision was made in the design of this pier for the future construction of a span of length equal to the south approach span. As protection against scour, the steel sheet-pile cofferdam used in building this pier was driven down into the river bed after the pier was completed.

NEW RIVER PIER (at right) was constructed in sheetpile cofferdam. Steel piles were driven under water and cofferdam sealed and pumped out. Pier was constructed in dry.

The track on the new bridge consists of 100-lb rail laid on tie plates. Inner guard rails are provided. The bridge ties are secured to the floor system by clip angles fastened to the top of the stringers. These clip angles are placed at every other tie and face in alternate directions. Every other tie in the three panels at each end of the lift span and in the end three panels of the adjacent fixed span is boxed in with rail anchors. Eight anchors per rail were applied for the entire length of each trestle approach and 16 per rail for the first 300 ft of track adjacent to the trestle approaches.

No welding was employed on the bridge.

Conley rail joints at each end of the lift span provide continuity of rail. These joints include rail locks which have some ability to hold the bridge locked in position. There are no bridge locks, but provision has been made for their installation if required.

The new bridge was built substantially on the center line of the old structure; the only change in alignment was that made necessary by the fact that the old bridge had been knocked off center by river craft.

NEW END PIER WAS BUILT, and old pier removed, under temporary beams extending out from end of approach span which carried bridge loads over pier site. New piers stand on steel bearing piles, though pneumatic caissons were considered.

The south approach trestle has been largely filled in and the portion not filled in has been rebuilt during the past few years. The north approach trestle will soon need to be rebuilt. The track was raised about 1 ft in the reconstruction of the bridge to provide the 7-ft under clearance with the lift span in down position.

Traffic was maintained without any serious interruptions from construction work except at the time the pier settled. When the swing span was removed and the lift span placed in service, both railroad and river traffic were interrupted for a period of about 30 hours.

The Ernest Construction Co. will carry out its contract for removing the old pier and fender and building a new fender when water conditions permit. The company expects to complete this work by September 1950.

The superstructure was designed by Harrington & Cortelyou, consulting engineers of Kansas City, Mo. The substructure was designed in the office of the writer.

Resident Engineer on the project for the Southern Railway Co. is M. A. Roose, Assoc. M. ASCE. Planning was carried out under the supervision of the writer. For Hardaway Contracting Co., D. R. Bird was superintendent, and construction was carried out under the direction of S. T. Jones, Assoc. M. ASCE, Jr., Vice-President. For the Virginia Bridge Co., J. C. Penry was superintendent and the erection work was in charge of C. E. Jacob, Assoc. M. ASCE, who is Manager of Erection. For Ernest Construction Co., W. C. Pierce is superintendent and the work was directed by J. P. Trotter, M. ASCE.

Must New Highway Construction Soon Become Overloaded and Obsolete?

Not If California's "Freeway Principle" Is Followed

FRED GRUMM, M. ASCE
Deputy State Highway Engineer, California Division of Highways, Sacramento

NEW HIGHWAY CONSTRUCTION in the past has often defeated the very end for which it was undertaken. A new or improved highway has frequently led to "ribbon city" developments. By encouraging the development of abutting property the new route has opened the way to serious loss of capacity, thus hastening its own obsolescence. Construction of additional lanes provided only temporary relief, and money and effort were wasted. The motor vehicle user, who contributed the funds for improving and maintaining the highway, was getting little return for his money. The abutting property owner, on the other hand, who contributed nothing from property taxes toward the improvement, profited by the increased values created and helped destroy the efficiency of the road by his improvements.

CALIFORNIA HAS BUILT 675 miles of freeways out of total declared state mileage of 1,440 for this type of highway facility. At present 98 miles are under construction under 1950–1951 budget of $90 million. Basic "freeway principle" is full control of access, but other important characteristics are divided roadway, separated cross traffic, no left turns and ample right-of-way. Here pictured are: TOP LEFT, Eastshore Freeway in Oakland, looking southeast from Fifth and Fallon Streets, with city limits in right upper background; MIDDLE, Cabrillo Freeway, in Balboa Park, San Diego, with Robinson Street Overcrossing in center background; BOTTOM LEFT, Arroyo Seco Freeway through South Pasadena, depressed section.

Although the statements in this article apply particularly to California, they are probably typical of other states and communities. The same phenomena can be found in the country as a whole or may be reproduced in smaller communites on a reduced scale. California's experience and progress should therefore be useful.

The need for highways with maximum capacity and minimum hazard probably developed gradually, but our awareness of the need came more suddenly. Diligent searchings for an adequate solution led to tentative consideration of the "freeway principle," the principle of control of access. It became a law in California in 1939. Here a freeway is "a highway in respect to which owners of abutting land have no right of easement or access to or from their lands or in respect to which such owners have only a limited or restricted right of easement or access."

The American Association of State Highway Officials has adopted the following definition of a freeway: "An expressway with full control of access," and an expressway is "a divided arterial highway for through traffic with full or partial control of access and generally with grade separations at intersections." Control of access in their adopted definitions is: "The condition where the right of owners or occupants of abutting land or other persons to access, light, air or view in connection with a highway is fully or partially controlled by public authority."

Definite requirements for the ultimate solution are the important features of the "expressway," such as divided roadway, separated cross traffic, no left turns, direct interchange facilities, ample right-of-way, no pedestrians, and simple and adequate signs, but the fundamental quality that creates the high, lasting character of the improvement is the "freeway principle" of limited access.

The freeway eliminates the conflicting traffic movements induced by the development of abutting property; it reduces congestion, accidents, and hazard; it produces greater freedom of vehicle movement and relieves the nervous strain of driving; it produces a highway facility with maximum traffic capacity and this inherent benefit is retained as long as the "freeway principle" is maintained.

Continuous uninterrupted traffic flow is the basic reason for the high capacity of a freeway. The "freeway principle" is flexible and adaptable. As part of a current improvement we need only to acquire adequate right-of-way, position the pavements to provide for expansion and thus provide for future needs, at the same time preserving the integrity and beneficial quality of the freeway.

The freeway is a much safer facility than the ordinary highway. The principal causes of accidents—side friction and conflicting vehicle movements—have been eliminated by the control of access. A comparison of accident ratios for Wilshire Boulevard in Los Angeles, a major traffic arterial, with the Arroyo Seco Freeway is interesting. Wilshire Boulevard, a street 70 to 80 ft wide, with six traffic lanes, no parking, controlled intersections, carrying approximately 40,000 vehicles daily, has an accident ratio of 2.53 per million vehicle miles. The Arroyo Seco Freeway, a six-lane divided freeway with no parking, no grade intersections, controlled access, carrying approximately 40,000 to 50,000 vehicles daily, has an accident ratio of 0.48 per million vehicle miles—one-fifth that of Wilshire Boulevard.

The design features of the freeway all contribute to make it the safer, more comfortable highway facility. Its divided roadways reduce the "approaching" type of accidents; its wider lanes and shoulders supplement the elimination of side friction to reduce the "overtaking" type; and separation of grades, with the elimination of left turns, reduces the "crossing" or "intersection" type of accident. The freeway is free of the faults of the ordinary road or street.

Indirectly, the freeway produces other benefits that make it a desirable addition to any community or area. It fosters economic growth and it enhances the value of adjoining and nearby properties sufficiently to more than offset the loss of tax revenue from the lands included within the right-of-way and thus removed from the tax rolls. The case study of the Bronx River Parkway made by John Nolen and Henry V. Hubbard and described in their book, *Parkways and Land Values*, illustrates this fact. The authors present proof that the parkway participated in increasing land values and that increases were greater in the narrow adjacent strip. They indicate that gains in land values of as much as 700 percent can be ascribed to the parkway.

The California Highway Department recently completed a study of sales of property abutting the freeway in San Joaquin Valley along State Highway Route 4—U.S. 99. All recorded sales of land abutting on the freeway and the frontage or service road, made after completion of the freeway, were examined. In no case was the payment for land less than the appraised value for which the right-of-way was acquired. Most of the sales ran from two to six times the appraised value at the time the right-of-way was acquired. The appraisals were based on fair market value and right-of-way was acquired at the appraised valuation. Similar increased values have been observed along other California freeways.

HIGH CAPACITY OF FREEWAYS has been shown by extended studies of Committee on Highway Capacity of Highway Research Board. Four-lane freeway has capacity of four city streets each 40 ft wide with parking prohibited, or eight city streets with parking allowed and with usual amount of left turns and pedestrian interference. Three freeways here shown form parts of U.S. 101 from San Francisco to Los Angeles: TOP RIGHT, Santa Ana Freeway, through southeastern part of Los Angeles from Soto Street interchange looking east; MIDDLE, Hollywood Freeway (State Highway Route 2) looking southeast toward Cahuenga Pass (high point), with Barham grade separation and interchange in distance; BOTTOM RIGHT, Bayshore Freeway, looking northeast through San Francisco (four-lane road to left is old state highway).

A brief review of highway developments in California in the last twenty years will throw light on the development and practice of the freeway principle. In the early part of the thirties, although traffic volume was steadily increasing, two-lane roads were still functioning fairly well except, perhaps, for some of the more important routes. These were taken care of simply by increasing the number of lanes. Traffic congestion troubles were not too widespread, but by 1935 they were attracting the attention of the engineer. The dismal effect of "ribbon city" developments became more pronounced and, ironically, on the very sections of highway which had been improved to greater capacity. Conflict of vehicle movements, congestion, and increased accidents always accompanied this development of abutting property, and the corollary was a disappointing loss of highway capacity. To cure this situation the California freeway law was passed in 1939.

Discreet application of the freeway principle produced only a few examples before efforts were halted by the war. Opportunity for observation of freeway performance under normal operation was limited as to time, and therefore the benefits produced were not announced until proof could be provided by further experience. We now have amplified the earlier experience; we have more substantial proof of the value of the freeway.

For the four war years, when maintenance operations were the only permissible activity on the highways, the California Highway Department devoted the time of its reduced engineering forces to a detailed study of the deficiencies of the state highway system and to the completion of plans for correcting these deficiencies. By the end of the war, these deficiencies had in many instances become critical and were so termed in the report of the Department to the legislature at its 1945 session. Of these deficiences the large majority—about 75 percent—were of the "inadequate capacity" type.

Whereas since 1920 (considered as base, or 100), motor vehicle registration and highway use in California increased to over 500 in 1947, expenditures on the state highway system to that same year barely reached the 250 mark and never exceeded the amount available in 1930. This condition was exaggerated and aggravated by the war.

The war's end served to highlight the accumulating inadequacies in the highway systems of the country as a whole as well as of California. The sudden release from fuel restrictions had the effect of a physical blow in the outpouring of traffic. All the highway shortcomings that had increased so inevitably in the nineteen thirties were suddenly alarmingly apparent. They exceeded the most pessimistic predictions.

The reporting of critical deficiencies on the state highway system to the California legislature in 1945 led to the appointment of a legislative Committee on Highways, Streets and Bridges. The committee's studies extended over a two-year period and, in addition to the state highway system, embraced county roads and city streets, from which the continuing increase in traffic had also exacted its toll. The road and street taxes collected by local governments were no longer sufficient to meet the demands of increased traffic.

In recent years a gradual shifting of the road burden from local government to the state has taken place. This shift has been partly in the transfer of roads and streets to the state highway system but principally in the state's assumption of a large part of the cost of county road and city street administration. These costs are a subsidy to the counties and cities from the state to the extent that very few property taxes are levied by the counties and cities for road and street purposes.

1947 Law Provides Additional Funds

The legislative committee's studies resulted in the introduction of bills at the 1947 legislative session providing for additional funds derived from taxes on motor vehicles and motor vehicle fuel for state highways, county roads and city streets. Over the organized and bitter opposition of the oil companies, the Collier-Burns Highway Law was finally passed. It provides increased funds for all three road systems.

The increased amount produced for state highways exceeds previous amounts by about four times, and that for new construction, about six times. It can be illustrated by using a typical year's allotment. The amount available for construction alone in the 1950–1951 fiscal year is approximately $92,000,000. Construction in the law is defined to include engineering, rights-of-way, and construction. The respective percentages of these three are 7, 21, and 72. At the present rate of income, which includes Federal Aid, about 15 to 20 years will be required to correct the reported state highway deficiencies, estimated in 1947 to cost more than 1.6 billion dollars.

We are now operating in the third year under the Collier-Burns Highway Act. A budget for the fourth year has been adopted and construction has gotten under way. Deficiencies receiving first attention are of course on major arterials and in the larger metropolitan areas. The capacities of these arteries are being increased and they are being improved as freeways. Adequate widths of right-of-way are being secured—a basic minimum of 170 ft—to accommodate a six-lane divided highway with all the necessary appurtenances, such as acceleration and deceleration lanes, channelized intersections, grade separation and interchange structures.

On some of the rural freeways, stage construction is being practiced. Such ultimate refinements as separation and interchange structures are being omitted temporarily, until traffic warrants are sufficient, but the design is developed and the right-of-way secured now so that these additional features, which are refinements now but will become necessities, can be readily fitted into place. Frequent use is being made of a design providing frontage or service roads where an existing highway is converted into a freeway and where abutting property has been developed.

At the end of the war, September 1, 1945, there were 588.8 miles of declared freeways in California, of which 328.7 miles had been completed as of June 30, 1945. At the end of 1949 (December 31) the status of freeways was as follows, in miles:

Total declared freeways	1,440.3
Total freeways under construction	98.2
Total completed freeways	675.2

Considerable progress is apparent on such main routes and interstate highways as U.S. 40, 60, 70, 99, and 101. The urban freeways in the Los Angeles and San Francisco Bay areas are being completed for serviceable distances, with some sections of the eight-lane divided type.

The California Department of Highways feels that the "freeway principle" is the most valuable feature of present highway design and provides the most complete service to traffic yet achieved. The freeway will be the principal component of the ultimate through highway system of California. This facility, instead of becoming quickly inadequate and obsolete, will continue its beneficial service indefinitely. Are we not entitled to say that we are making progress toward the ultimate in highway transportation?

This article is based on the paper presented by Mr. Grumm before the Highway Division at the ASCE 1950 Annual Meeting.

River and Tide Effects—Lower Colorado River

Surveys Show Natural Barriers Unchanged by Upstream Regulation of Colorado River

L. M. LAWSON, Hon. M. ASCE

Commissioner, U.S. Section, International Boundary and Water Commission, El Paso, Tex.

SINCE MOST of the silt load formerly carried by the Colorado River into its delta has been retained above Hoover Dam since 1935, the question has been raised as to whether the previous building processes in the delta might have been reversed, thus permitting the tidal bore at the mouth of the river to erode its way through the delta and inundate the highly developed Imperial and Coachella Valleys. The International Boundary and Water Commission, United States and Mexico, charged by the 1944 Treaty with the responsibility of studying such problems involving both countries, has been watching the situation in the delta for many years, and has found no indication that such action is taking place. On the contrary, the problem remains one of aggradation of the lower river channel, causing the Colorado to overflow into Imperial Valley as it did in 1905.

The Colorado River enters its delta near Yuma, Ariz., below which point it forms the boundary between the United States and Mexico for a distance of about 20 miles, and then continues south about 90 miles through Mexico to enter the Gulf of California.

The delta extends from the mouth of the river northwest 70 miles through the Mexicali Valley, across the international boundary in the vicinity of Calexico, Calif., and continues in a northerly direction through the Imperial Valley to the Salton Sea (Fig. 1). The active part of the delta through which the river now flows is on the eastern slope of the basal delta cone and is bounded on the east by the Sonora Mesa and on the west by the Cocopas Mountains. Also extending northwest from the mouth of the river is the small basin known as the Laguna Salada, which is separated from the Mexicali Valley and the Imperial Valley by the Cocopas Mountains.

Mexicali Valley Encroachment Blocked

From recent surveys a profile, Fig. 2 (*a*), has been developed extending from a point in the Gulf 40 miles below the mouth of the Colorado River, through the Mexicali and Imperial valleys to the Salton Sea. This profile shows that 50 miles from the mouth of the river the basal cone of the delta forms a barrier about 40 ft high. Measuring from sea level on the Gulf or south side to sea level on the Imperial Valley side, this barrier is about 65 miles long. A comparison of early and recent surveys shows that the Gulf has not encroached on this barrier in the past 50 years.

Mountain Bars Laguna Salada Path

Another profile, Fig. 2 (*b*), developed from recent surveys, extends from the mouth of the river northwestward through the small Laguna Salada Basin. The saddle separating this basin from the Gulf is 22 miles northwest of the mouth of the river and has an elevation of about 15 ft above mean sea level. From this point, the surface slopes northward about 60 miles to below sea level but here the Cocopas Mountains form a rock barrier, the lowest elevation of which is 160 ft. Near that elevation the barrier is a mile wide. Certainly there can be no question as to the formidable nature of this barrier. However, there is no indication that the Gulf is advancing toward this basin. At the present time, the Laguna Salada Basin is dry. In the past 50 years there has been water in it but records show that it was fresh water—overflow from the Colorado River in times of flood, when its flow to the Gulf was impeded by extremely high tides.

Hence, there is no evidence that the Gulf is advancing toward the Salton Sea in the United States, either through the Mexicali Valley or through the Laguna Salada Basin.

An aerial survey was made of the lower Colorado River in 1949, one of the purposes of which was to study possible local changes at the mouth. Just off the mouth (1.6 miles) is the deltaic Montague Island, seen in profile in Fig. 2. Depths in this area are comparatively shallow. At low tide, bars in and around the mouth become exposed, and at extreme high tide much of Montague Island is flooded. Attention is particularly invited to the fact that this island con-

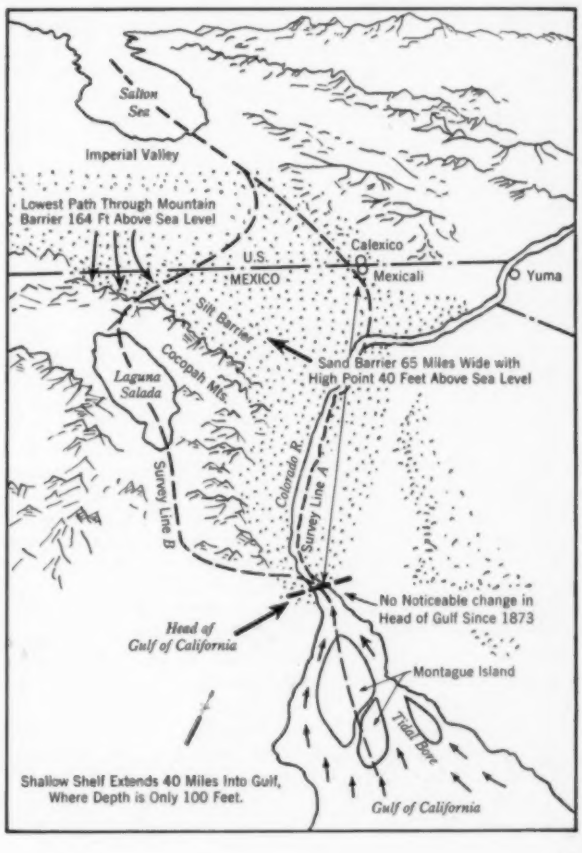


FIG. 1. MOUTH of Colorado River has shown no perceptible regression in past 75 years. Paths of possible encroachment of Gulf of California are through Mexicali Valley (right) and Laguna Salada Basin (left). Profiles in Fig. 2, run approximately along lines *A* and *B*, show that natural formations constitute formidable barriers.

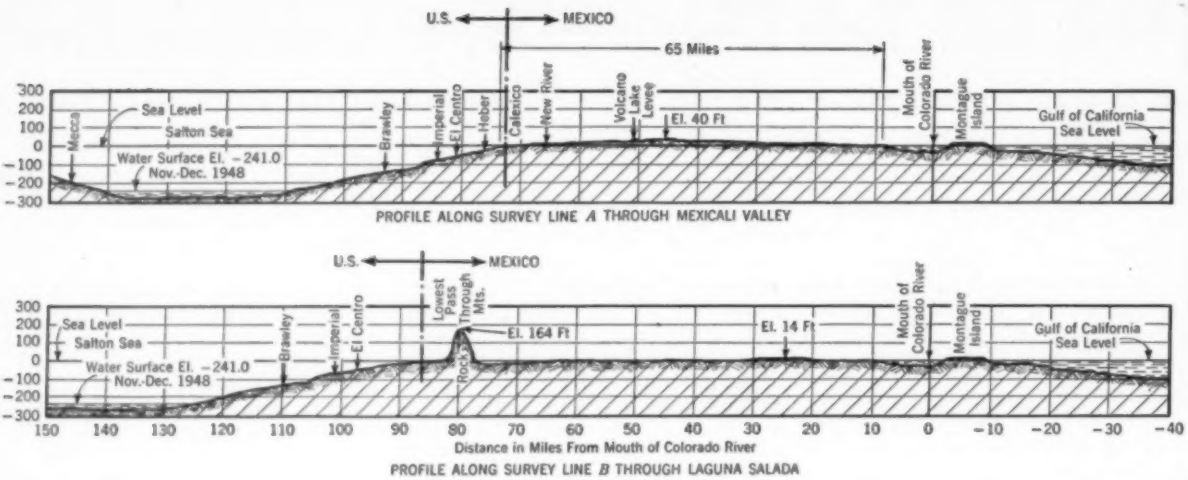


FIG. 2. PROFILES along lines *A* and *B* of Fig. 1 refute view that Gulf of California might flood Imperial Valley. Surveys of possible paths of encroachment show extent of natural barriers.

sists of deltaic sands and silts, not resistant to erosion.

An aerial survey which included the mouth of the river was made in 1942, and a comparison of this with the survey made in 1949 shows that there have been no material changes in the topography at the mouth in the intervening seven years. The distance from Montague Island to the well-defined mouth of the river was 1.6 miles seven years ago, the same as last year. There was not even a perceptible change in the outline of the island or in the small tidal channel referred to previously.

A study has also been made covering the longer period. A hydrographic survey of the upper end of the Gulf, made by the Navy in 1873–1875, shows that the mouth of the river was at the same latitude then as now, and that Montague Island was in the same location. Thus, it can be said that there has been no appreciable change in the mouth of the Colorado River in the past 75 years.

This conclusion is particularly significant. The decrease in the amount of silt carried by the Colorado River into the Gulf does not date from the closure of Hoover dam in 1935 but rather from 1905, when the river broke out of its channel near the California boundary. Since that time, the river has maintained no single well-defined channel through to the Gulf. Instead, it has divided into a number of smaller distributary channels and has deposited the major part of its silt load in distributary areas located above the influence of the tide. In fact, during the past 45 years the river has carried little silt into the Gulf, and there is no evidence of retrogressive activity at the mouth of the river in this period. If there is such activity, it is extremely slow and can be measured only in geologic time.

Because of the funneling in of the Gulf as it approaches the Colorado's mouth, high tides are experienced. The diurnal range as recorded in the tide table is 23 ft, and the range in spring tides has been noted in charts as about 30 ft. Before the construction of Hoover Dam, it was observed that spring tides entered the mouth of the river as a bore 6 to 7 ft high. Since then, it is reported, the bores have diminished in size. This seems reasonable since the extreme conditions were no doubt due in part to the outgoing flood waters of the Colorado River clashing with the incoming tide.

Location of Tidewater Head Unchanged

Studies have also been made to determine whether or not there has been any change in the location of the head of tidewater. The Navy map of 1873–1875 indicated that this head was about at latitude 35° 06′, or about 20 miles north of the mouth of the river. The first detailed map of the delta made in 1904 shows the head of tidewater at about the same latitude, and recent gage records by the International Boundary and Water Commission show that the head of tidewater is still about 35° 06′. These observations further refute the theory that there have been retrogressive changes at the mouth of the river in the past 75 years.

Rather than any retrogression of the Gulf into the delta of the Colorado River, the natural building processes have continued there since 1935, and a secondary deltaic cone is being formed in the distributary area above the head of tidewater and about 40 miles upstream from the mouth of the river. This cone is adding to the southern slope of the existing barrier between the Gulf and Imperial Valley. The material forming in this cone is sand from the Colorado River below Parker Dam. Even though the total sediment content of the river has been greatly reduced, the river is still carrying considerable quantities of sand into the delta and will continue to do so as long as materials of this type are brought by arroyo flows into the 150-mile stretch below Parker Dam. In addition, the Gila River, which joins the Colorado just above Yuma, is capable of discharging enormous quantities of sand and silt into the delta as it has done in the past. It is evident that the flows entering the delta will continue to diminish as a result of the regulation of upstream reservoirs and increased upstream uses until there is little flow to carry the sediment through to the Gulf. The important problem therefore is deterioration of the existing meandering channel and continued aggradation rather than retrogression from the Gulf.

In the absence during the past 15 years of the scouring floods which occurred before the construction and operation of Hoover Dam, the channel in the delta has deteriorated. This channel has been encroached upon by native vegetation and by siltation along the banks until its capacity has been materially reduced. Continued deterioration of the channel will increase the danger of overflow from the river into Imperial

Valley during the infrequent but still great floods which may be expected to enter the delta, particularly from the Gila River. And aggradation of the channel will seriously affect drainage in the irrigated areas adjoining the river in the United States and Mexico.

The remedy for this difficulty appears to be twofold: (1) Construction of a flood control dam on the Gila River about 100 miles above Yuma, as suggested by the United States Section of the International Boundary and Water Commission, and as recommended last year by the Corps of Engineers (Legislation authorizing construction of this dam is being considered by Congress.); and (2) rectification of the river channel from Imperial Dam to the Gulf to provide an efficient sluiceway for the small future flows so that they can carry sediment through to the Gulf. Studies for such a project, which would be a joint one between the United States and Mexico, were authorized by Article 13 of the 1944 Treaty. Field surveys are now being carried on by Mexico, and office studies are also under way so that plans for this joint project can be submitted to the two governments for consideration and approval.

The natural building processes in the delta have not been reversed; on the contrary they are still going on, strengthening the existing barrier between the Gulf and Imperial Valley. There is no evidence that the Gulf is advancing into the delta. The problem in the delta continues to be, as it has been in the past, that of controlling the river because of the upbuilding of the delta by the deposition of river sediments.

Mr. Lawson's paper, on which this article is based, was originally presented by J. F. Friedkin, Assoc. M. ASCE, Engineer, International Boundary and Water Commission, United States and Mexico, U. S. Section, before the Engineering Economics Division at the ASCE Los Angeles Meeting.

Stable Construction Costs for Next Year or Two Predicted

Gradual Rise in Costs Then Foreseen if Present Economic Policies Are Continued

GEO. H. ATKINSON
President, Guy F. Atkinson Company, South San Francisco, Calif.

ARE present costs of engineered construction relatively stable or are drastic ups or downs in prospect? This question is important to owners and engineers who must decide whether to rush or retard projected programs.

To answer this question it is necessary to examine the main factors which determine construction costs. These factors may be divided into two groups—those entirely beyond the control of the owner, engineer and contractor, and those which are generally controllable, to some extent at least, by the construction industry as a whole. The factors in the first group, that is, beyond the contractor's control are: National financial and economic policies; hourly wage rates; relative efficiency of labor; cost of materials, supplies and utilities; construction volume; and taxes. There are other factors in this category but these are the main ones.

Factors Not Controllable by Construction Industry

National policy is probably the most important basic factor in this group, because either politically or economically it tends to influence all the others. This broad subject cannot be discussed in detail but it can be observed that the present policy, based on easy credit and unbalanced budgets, probably will continue for several years in the future. This policy tends to be mildly inflationary and has a pro-labor emphasis resulting in slightly higher wages, increased social benefits, and in the end, higher material costs. In brief, leaving all other factors out of consideration, it should be stated that continuance of the present policies would indicate a constantly, though slowly, rising cost of construction as measured in dollars.

Hourly wage rates used to be controlled to some degree by supply and demand, but with the unionization of labor generally, this old economic law no longer works. If there is a shortage of labor and men are in demand, wages increase, but when the reverse is true and there is a surplus of labor, wages no longer decrease because the unions cling tenaciously to their previous gains as the floor under which no later wage is allowed to fall. Supply and demand therefore no longer have any balancing effect. Thus, unless there is a general economic upheaval, which is at present not anticipated, wages probably will not go any lower. In fact, with the continued pressure from the membership of the unions and the political strength of labor generally, it appears that hourly wages will continue to rise gradually. Historically this has certainly been verified; common labor has risen from some $1 a day to $12 a day in the past 40 to 50 years, and there is no reason to believe that this general trend will be reversed.

Increased efficiency of labor in many cases compensates for increases in hourly wage, and this efficiency factor is affected by the volume of work and supply of surplus labor on hand. Efficiency during the war reached a low stage, and during the immediate postwar period it dropped even lower. Only in recent months has recovery been noted. Inasmuch as the great increase in construction costs during and after the war resulted as much from a loss in labor efficiency as it did from increased wages, it is reasonable to assume that the recent increase in worker output undoubtedly accounts for much of the 5 to 15 percent decrease in construction costs which is currently reported. Further continuation of this improvement can be expected and this may tend almost to offset any hourly wage increases within the next year or two.

Costs of materials, supplies, and utilities also depend greatly on labor rates. Some studies have shown that as much as 93 percent of all construction costs eventually go back into payments to labor—whether it be on the job, in the

factory or in the mine. Therefore the rising cost of labor would seem to indicate a further rise in the cost of materials. On the other hand, costs of materials are reduced by improvements in production techniques, new inventions, and the like. Therefore, with postwar scarcities a thing of the past, the material market is remaining approximately steady, and in some cases even appears to be heading downward as a result of increasing competition in general industry. Nevertheless, basic products such as steel and lumber are again on the rise; and so the best forecast that can be made at this time is that the material market will remain fairly steady, with possibly a general increase in prices in future years following the general inflationary trend of our fiscal policy.

Volume of construction naturally affects prices considerably. When volume is normal, labor and material costs are not affected too greatly; but any large decrease in volume results in lower material prices, greater labor efficiency, and severe competition among contractors, all of which result in lower costs. Abnormally high construction volume results in scarcities of material and labor, which adversely affect prices. The present volume of some 20 billion dollars a year reflects both normal construction activity and the Government-sponsored housing program, with its guarantees of credit and low interest rates. This policy now seems well established, and there appears to be no reason to anticipate any great fluctuation in construction volume in the foreseeable future.

Taxes in all forms, especially social security taxes and other benefits, are becoming increasingly important in their effect on cost of construction. A thorough exploration of this subject would take more space than is available, but it is sufficient to say that the present tendency of all taxes is to increase, and each increase brings greater total costs.

Factors Controllable by Construction Industry

The second group of factors bearing on construction costs are those which are largely within the control of the construction industry. Four main factors will be discussed in this category—improvements in methods and equipment, husbanding of labor, technological advances, and cooperation between engineers and contractors.

Improvement in methods and equipment on the part of the construction industry has been one of the main factors counterbalancing the steady price inflation that has been under way ever since the turn of the century. Although labor, equipment, and material prices have all risen greatly during this period, the efficiency of operation has so improved that prices for many classes of machine excavation have changed very little since before World War I. This is true of many other classes of work, and while there is some question as to the rapidity of further development, there is little doubt that there will be additional improvements in every line as time goes on. In some lines, machine excavation in particular, it may continue to offset all other increases in cost.

Husbanding of labor is another counterbalancing trend. Closer and more intelligent supervision, better planning, a continual training program for foremen and skilled laborers alike, and improved employee morale are some of the items contributing to better use of the labor force which is available. In general, the construction industry has been slow to adopt these practices, much slower in fact than manufacturers, who have a much more stable labor force. With constantly increasing wage rates and material prices to counteract, however, the very life of the industry depends on its ability to get certain projects done within the limit of their economic feasibility; and the current effort towards more effective use of our labor force is a promising development.

Continuing technological betterments in general design and specification requirements for structures are among the chief factors increasing the cost of current construction. These improvements undoubtedly will result in more durable structures which will be great economic assets to future generations; but it should be noted that as a result of the many technological refinements, such as precooling of concrete aggregates for instance, the mass concrete in many of our modern-day dams costs considerably more per yard than it would if only prewar standards were required. Undoubtedly these improvements will continue to be made, and so in this field we have a continuing pressure which tends to raise costs.

Cooperation between engineers and contractors to hold down construction costs takes many forms. Some engineers and Government agencies are regularly reexamining their standard specifications, seeking to eliminate ambiguous and expensive requirements where there is no compensating gain for the extra cost involved. Their effort is for more clarity and definiteness in specifications, and for plans and designs which, with no sacrifice in quality or soundness are more practicable of accomplishment with the equipment and resources at the contractor's disposal. The elimination of certain hazardous contingencies and the assumption by the owner of large risks such as water control hazards, have already saved certain Government agencies substantial sums of money. Joint cooperative groups such as the AGC-ASCE Joint Committee are making significant contributions. Continued progress along these lines tends to reduce construction costs.

Conclusion Is Fairly Stable Costs for Next Year or Two

To sum up, it appears that the general factors of national policy, hourly wages, material prices, construction volume, and taxes, while running about level and with only minor variations at the moment, will when combined with the additional costs of the constant refinements in construction requirements, tend towards gradually higher prices. On the other hand, these factors can be somewhat counterbalanced by some possibility of a further increase in postwar labor efficiency, better husbanding of the labor forces we do have available, continued improvement in construction methods, design, and use of materials, and a growing effort on the part of engineers and contractors alike to work more closely together for the solution of their problems.

Attempting to place all these factors in their proper perspective, it appears that, barring a sudden war or other catastrophe, dollar costs probably will not recede much more, nor should they increase a great deal in the next year or two.

It seems likely that the present plateau, with some minor fluctuations, will continue at least during this period, and then will gradually ascend, the speed of the ascent depending, of course, on the degree to which we continue to pursue our present general economic policies.

From address before Engineering Economics Division at Los Angeles

PENNSYLVANIA TURNPIKE, high-gear high-speed toll road, connects Philadelphia and Pittsburgh by route through Allegheny Mountains. Financial success of Turnpike has stimulated wave of toll-road construction in other states, including New Jersey and New York.

The Turnpike—Pennsylvania's Largest Business Venture

FARLEY GANNETT, M. ASCE
President, Gannett Fleming Corddry & Carpenter, Inc., Harrisburg, Pa.

STARTED IN 1935 as a PWA relief measure, the Pennsylvania Turnpike has turned into Pennsylvania's greatest business venture, a $239,000,000 business with eventual revenues of over $23,000,000 a year. It is now, and will continue to be self-supporting without relying on state or federal financial help except for the $29,250,000 PWA grant which started it off.

Turnpikes in Several States

A wave of turnpike construction is sweeping the country (see Fig. 1). The central section of the Pennsylvania Turnpike was the first; then Maine built a 45-mile toll road from the state line north to Portland; New Hampshire is just completing a short toll road across the state, south from Portsmouth; Pennsylvania's Eastern and Western Extensions came next; New Jersey has started its $220,000,000 road extending 118 miles from the Wilmington Delaware bridge to the George Washington Bridge at New York City; Ohio is to start very soon on a turnpike from Youngstown to Toledo; West Virginia is talking of one to run from north to south across the state; Oklahoma proposes one from Oklahoma City to Tulsa, 100 miles; Colorado is discussing a short one from Boulder to Denver; in Texas, a corporation has been formed to build one from Dallas to Houston; North Carolina has authorized a toll road; and the Georgia Legislature is considering one.

The 160-mile central portion of the Pennsylvania Turnpike was built during the depression with a $29,250,000 grant from the PWA, plus a bond issue of $40,800,000 sold to the RFC. The job was started in 1935 and completed in 1941. It has been successful, particularly so since the war. The revenue of more than $7,000,000 for the year 1949 was above the preliminary estimate and helped materially to sell the bonds for the Eastern Extension.

Cost of Pennsylvania Turnpike Extensions

As against the $70,050,000 cost and five-year period required to design and build the original 160-mile road, the Eastern Extension from Carlisle

TABLE I. COST OF TOLL ROADS, BUILT AND PROJECTED

Location	Length Miles	Total Cost in Millions	Cost per Mile in Thousands	Status
Pennsylvania Turnpike, Central	160	$70	$ 461	Operating
Eastern Extension	100	86	861	Under construction
Western Extension	67	78	1,169	Under construction
Maine Turnpike	45	20.6	450	Operating
New Jersey Turnpike	118	220	1,900	Under construction
Oklahoma City–Tulsa	100	35	350	Projected
Ohio–Youngstown–Toledo	200	250	1,250	Projected
New York–Buffalo Thruway	425	500	1,200	Authorized

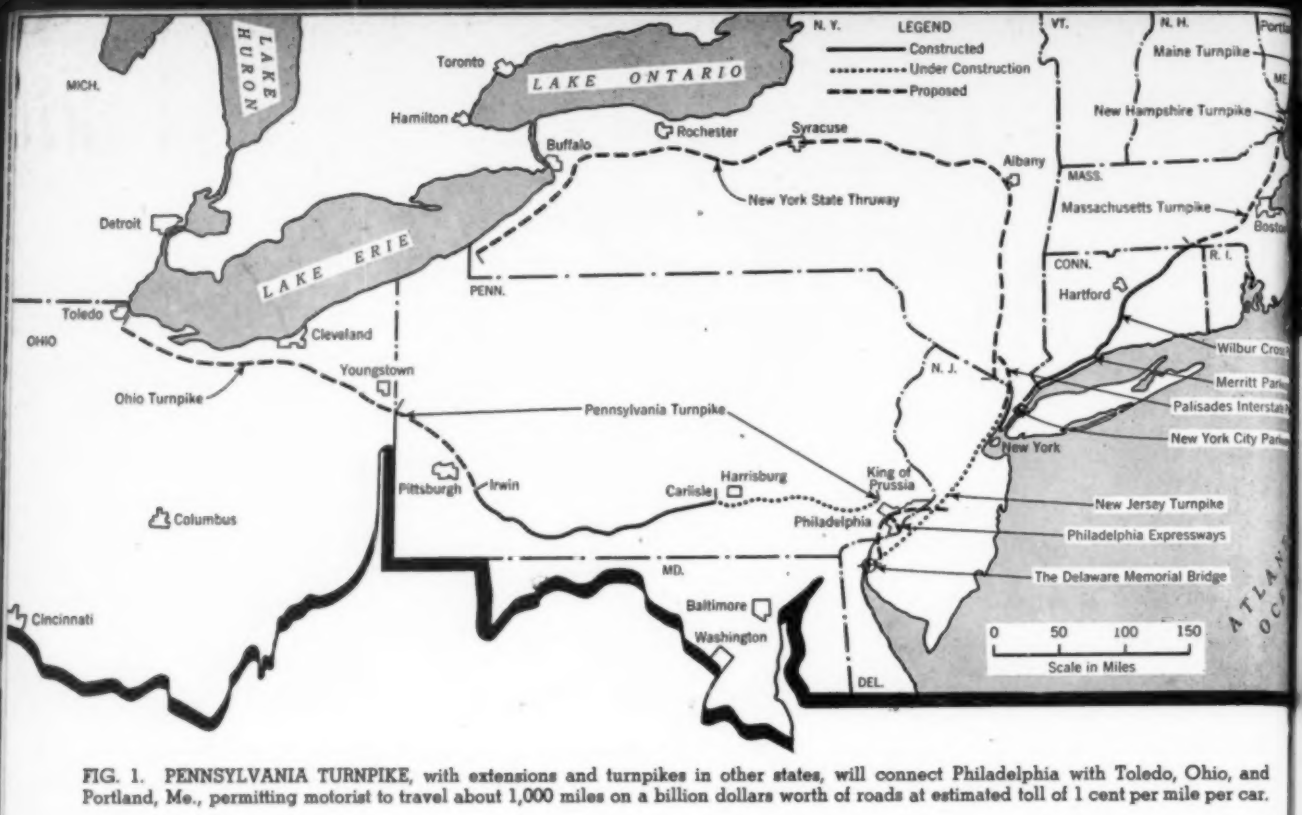


FIG. 1. PENNSYLVANIA TURNPIKE, with extensions and turnpikes in other states, will connect Philadelphia with Toledo, Ohio, and Portland, Me., permitting motorist to travel about 1,000 miles on a billion dollars worth of roads at estimated toll of 1 cent per mile per car.

to the Philadelphia suburbs will cost about $87,000,000 for 100 miles and take a little over three years to design and build, and the Western Extension from east of Pittsburgh to the Ohio line, 67 miles, will cost about $77,500,000 and take 2½ years. The total cost for the 327 miles across the state will be about $239,000,000. The only thing about the two extensions that is cheaper than the original road is the engineering for location and design, which was let by contract to consulting engineers. On the original road the Commission formed its own surveying and design staff.

The final location and estimates of cost of the Eastern and Western Extensions of the Turnpike were made by our company under the direction and with the cooperation of R. B. Stone, chief engineer of the Pennsylvania Turnpike Commission, and his assistants.

The Eastern Extension follows the foot of the hills to the north of Lancaster and Chester valleys and of course misses all cities and towns. The Western Extension, started two years later, swings north of Pittsburgh, south of Butler and New Castle, and hits the Ohio line near Youngstown.

327 Miles of Turnpikes

When the Western Extension is completed in 1951, a motorist will be able to go from the community of King of Prussia near Philadelphia, to the Ohio State line near Youngstown, Ohio, at a steady rate of 50 to 70 miles an hour, depending on his desire or the type of vehicle he is driving, for 327 miles, with no road crossings, no red lights, no grades to require a change of gear. The toll will be slightly over $3.00 for a passenger car and considerably more for trucks and busses.

With the toll roads now under design or already built, the traveler will be able to step into his car in Philadelphia and without interruption from red lights, hills, or trucks go at high speed to Toledo, Ohio, 500 miles to the west, or with short breaks about 500 miles to the east, to Portland, a total distance of about 1,000 miles. If all these roads cost about what the Pennsylvania Turnpike is costing, this traveler will be using nearly a billion dollars worth of roads on his trip. The toll will be about $10, or 1 cent per mile per car.

In the building of these turnpikes the procedure has been to borrow money from the state highway department to pay for traffic report studies up to the point of obtaining consulting engineers' reports on the cost of construction and right-of-way and on the revenue to be expected. If the engineer's report was satisfactory to the bankers, they bought the bonds and the Banking Syndicate sold them to the public.

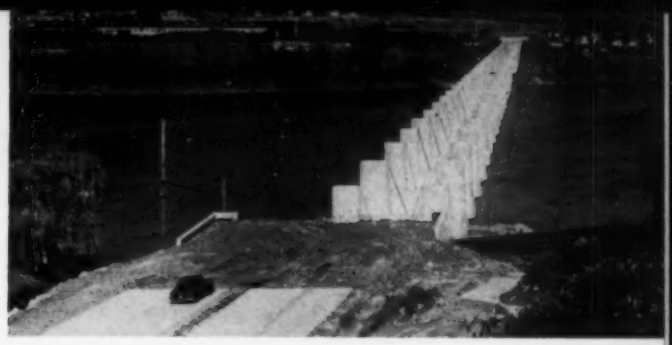
Next, design and construction began. Since interest starts on the entire bond issue years before revenues begin to come in, the engineers are pushed to get construction under way, and the contractors are similarly driven at top speed. On the Eastern Extension this bond interest is about $7,885 a day, but as the funds are temporarily reinvested, the interest loss is cut down. On the New Jersey road bonds are to be sold to insurance companies and other large corporations as money is needed.

Bonds Provide Funds

Almost all these toll roads are being or will be built with money raised by the sale of bonds, whose sole security lies in the revenue from tolls. They are not a liability of the state or of the Federal Government and they are free of federal income tax. Those built so far are self-supporting. One of the bankers who sold the Pennsylvania Turnpike bonds called them "the glamour girls of revenue bonds."

The money raised by the sale of these bonds is venture capital—wonderfully cheap venture capital, too. The recent bonds for the Turnpike's Eastern Extension are 3¼-percent coupons, now quoted nine points above par. The Western Extension bonds are 2.9 percent coupons and are selling at 106 and better. The 2¼-percent bonds on the central operating section are quoted at 106¼. The coupon on the New Jersey Turnpike bonds is for 3¼ percent.

CRANES LIFT steel girders to abutments of bridge carrying Route 111 over Eastern Extension of Pennsylvania Turnpike. All grade crossings are eliminated on Turnpike which, with Eastern and Western Extensions, runs 327 miles across state.



CONCRETE PIERS will carry Eastern Extension of Pennsylvania Turnpike over Susquehanna River and two railroads near Highspire, Pa. Bridge costing about $5,000,000 was designed by Parsons, Brinckerhoff, Hall & Macdonald, New York, N.Y.

This cheap venture capital produces new jobs, new services, a market for large volumes of cement, steel, and construction equipment and does not take money from any competing business.

The Pennsylvania Turnpike is also a freight carrier. Latest reports show that of the gross revenues received in the last year, about 65 percent came from trucks. This has two advantages—it helps pay for the road, and the trucks are taken off the other roads, which makes passenger traffic on them better and safer and cuts down the wear and tear on them.

On account of this heavy and speedy traffic, the Turnpikes have to be specifically designed. The drainage is particularly important to keep the soil under the paving dry. The Pennsylvania Turnpike Commission has provided for placing a specially prepared granular subbase under the concrete for this reason, in addition to many miles of drain pipe (see Fig. 2). On the section of the New Jersey Turnpike across the Newark Meadows, some 8,000,000 cu yd of good earth material will have to be imported to form a satisfactory foundation, and vertical sand drainage wells are to be drilled to keep the underlying material drained.

It is interesting to compare the costs of these toll roads based on the respective bond issues for their construction. The central section of the Pennsylvania Turnpike cost roughly $70,000,000 for 160 miles, or approximately $461,000 per mile, including 6 tunnels, but it was built during a period of low prices and stiff competition among contractors. The eastern 100-mile extension will cost approximately $861,000 per mile with no tunnels, but including the long bridge over the Susquehanna River. The western extension of 67 miles will cost approximately $1,169,000 per mile, including two costly bridges over the Allegheny and Beaver Rivers.

Cost Data on Other Turnpikes

The Maine Turnpike, 45 miles long, cost about $450,000 a mile. The 118-mile New Jersey road will cost about $220,000,000, or nearly $1,900,000 a mile. All toll roads are 4-lane throughout, except the New Jersey road, the north section of which is 6 lanes wide, with provision for widening to 8 lanes. Property damage is very heavy and construction of the north section is exceptionally costly, largely because of foundation conditions. The 100-mile, 4-lane Oklahoma road is estimated at $35,000,000 or only $350,000 per mile. This is said to be due to low concrete costs, few costly structures and good foundations. The Ohio road is estimated at about $1,250,000 a mile for its 200 miles.

During the first complete fiscal year—June 1, 1941, to May 31, 1942—the revenue of the Pennsylvania Turnpike was $3,090,852.17. For the fiscal year June 1, 1948, to May 31, 1949, the revenue was $6,325,404.37. The operation costs for this period were $1,334,121.62 which left a net of $4,991,282.75 for interest and retirement. The big month is August for both cars and trucks. In winter the trucks usually yield twice as much revenue as passenger cars.

It is estimated that when the Philadelphia extension is completed, it will carry, during its first year, over 2,250,000 vehicles. This traffic would include some 1,500 trucks a day, coming to or going from Philadelphia. The Turnpike Commission engineers estimate a daily average of nearly 5,000 passenger cars a day over the Philadelphia Extension.

It's going to be bad this fall when the Eastern Extension starts operating because the roads to take the traffic away from the eastern end of the Turnpike will not be completed by that time. But later a fine boulevard will be built down the Schuylkill River to Philadelphia and to connect with the Camden Bridge.

Why has this sudden burst of toll-road enthusiasm spread all over the country? This is what Paul Troast, Chairman of the New Jersey Turnpike Authority, says about it:

"The conventional means of financing vitally needed routes by new 'State' bond issues, or increased taxes, is not politically practical in view of the attitude of the voting public. In a nutshell, road building in many states is considerably behind schedule—in some cases as many as 20 years—and the money to build public roads is not available."

It is reliably reported that something over 40 billions of dollars will be required to build our U. S. road system up to present needs. Most states are worrying over how to raise money for their requirements. The toll road is one answer, anyway for a part of the problem.

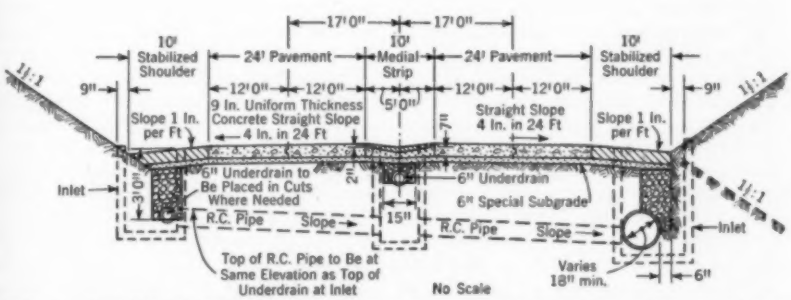


FIG. 2. DESIGN OF EASTERN Extension to Pennsylvania Turnpike makes special provision for drainage of each roadway.

New Jersey Builds $220,000,000 Turnpike

Construction Financed by 3¼-Percent Revenue Bonds on "Forward Commitment" Basis

CHARLES M. NOBLE, M. ASCE

Chief Engineer, New Jersey Turnpike Authority, Trenton, N.J.

PROGRESS on the New Jersey Turnpike project has been rapid during the past twelve months with the result that construction has already started on several sections. The project incorporates advanced techniques and modern functional concepts developed in recent years by highway engineering experience, and the financing plan has opened new fields in revenue bond financing.

The legislative act creating the New Jersey Turnpike Authority became law in October 1948. The Commissioners, Paul L. Troast, Chairman; George F. Smith, Vice-Chairman; and Maxwell Lester, Jr., Secretary-Treasurer, were appointed by the Governor and approved by the State Senate on March 31, 1949. The first turnpike was authorized by the Legislature and became law on April 14, 1949.

Early action by the Commissioners was the selection of four nationally known firms of consulting engineers to make engineering, traffic, and revenue reports on the financial feasibility of the project. The firms were: (1) Edwards & Kelcey, Frederic R. Harris, Ammann & Whitney, and O. J. Porter, Associated; (2) De Leuw, Cather & Co.; (3) Coverdale & Colpitts; and (4) Howard, Needles, Tammen & Bergendoff. The engineers were directed to complete the studies and reports for the turnpike in the unprecedented time of four months.

Extending for 118 miles in a north-south direction, the turnpike begins in the north near the west end of the George Washington Bridge over the Hudson River opposite New York City, and terminates in the south, at Deepwater, N.J., where it will connect directly with the Delaware Memorial Bridge, now under construction, a few miles below Wilmington, Del.

Through 16 traffic interchanges, including one at each terminal, this modern express highway will serve the people of New Jersey and the eastern half of the nation in a manner hitherto considered impossible. The turnpike runs close to, and will serve the cities of Wilmington, Philadelphia, Camden, Trenton, New Brunswick, Elizabeth, Newark, Jersey City, Passaic, Paterson, Hackensack, New York and many other communities. In addition, it will provide a major highway connection which has long been needed between existing important interstate and state highways.

Highway movements of great magnitude occur between the cities along the Eastern Seaboard and from the East to the Mid-West. The journey by motor vehicle across New Jersey has long been known as difficult and slow. The turnpike will make an important contribution to a free flowing highway movement along the entire Atlantic Coast.

It is anticipated that in a few years the New Jersey Turnpike will connect directly with the Pennsylvania Turnpike at a point north of Philadelphia. With the easterly and westerly extensions of the existing Pennsylvania Turnpike planned for completion in the next two years, and the further connection with the proposed Ohio Turnpike south from Cleveland for which legislation has been enacted, the movement of highway traffic to and from the Middle West, and along the East Coast by way of the New Jersey Turnpike, will be greatly expedited. Improvements now under construction in Maryland, New York and Connecticut, in conjunction with the New Jersey Turnpike, as shown on the map on page 36, will further expedite the flow of traffic.

Existing Highways Badly Overloaded

Need for the New Jersey Turnpike stems from congestion and overloading on existing highways in the State of New Jersey, and the fact that public revenues available for new construction are not sufficient to provide the highway facilities urgently needed today. Actually there are few if any highways of equivalent length in the United States which can compare with the New Jersey Turnpike in regard to the heavy concentrations of population, industry, wealth, commercial activity and highway traffic served. The State of New Jersey, although forty-fifth in size, is a corridor for interstate vehicular traffic. It ranks sixth as an industrial state and lies in the center of a group of northeastern states which contain 24 percent of the population and 35 percent of the industry of the entire country. It is situated between the states of New York and Pennsylvania, which have the first and second largest populations, and between the two great seaports of New York and Philadelphia, the first and third largest cities in the country.

All highway traffic between these two cities, as well as that approaching New York City from the south and west, and practically all highway traffic from eastern New York and New England, passes through New Jersey. Since the war, New Jersey traffic has increased 25 to 50 percent. The result is congestion and overloading on public highways. For example, on U.S. Highway No. 1 in Newark, 31.5 percent of all traffic is out-of-state and 8.6 percent is out-of-state truck traffic. This highway carries an average daily volume of 61,000 vehicles, and volumes above 100,000 have been recorded.

In the 6-mile-wide traffic corridor between the Orange Mountains and Newark Bay, there is an average daily north-south traffic of 256,000 vehicles flowing over state highways and local streets. All these facilities are overloaded, and delay and congestion are common. It has been estimated that economic losses from such delays exceed $4,000,000 a year in this small area alone.

Since the N.J. State Highway Department does not have finances adequate to meet the urgent highway needs of today, construction of the turnpike offers the quickest, and in fact the only, practical solution of the problem.

Financing Accomplished by Revenue Bonds

If the turnpike were to be constructed with current state funds, nearly ten years would be required for its completion if all the funds available for new construction—approximately $25,000,000 annually—were used solely for that purpose. Meanwhile, no new roads could be built elsewhere in the state. If the turnpike were to be built in the normal manner with concurrent construction of roads in other areas, from 35 to 50 years would be required for its completion. In contrast, the present construction schedule calls for completion in November 1951.

The over-all cost of the New Jersey Turnpike, including construction, ac-

quisition of right-of-way, service areas, engineering costs, interest during construction, and a contingency reserve (which may or may not be required) was estimated in the preliminary reports at $230,000,000. Methods of financing were under study from the date of the appointment of the three Authority Commissioners. When the preliminary engineering reports were completed in mid-September, the project was shown to be economically sound.

The surveys of traffic and revenue estimated the average annual revenues at $10,030,000 during the first five years of operation from 1952 through 1956. With the exception of the first year of operation, 1952, revenues will be adequate to cover the interest on the bonds outstanding and operating costs, and in addition will produce sums to be applied toward amortization of the bonded debt. For 1952 the revenues from tolls and concessions are estimated at $7,686,000, and they rise steadily each year until, in 1975, they are estimated at $22,360,000, or treble those of 1952. On the basis of revenue schedules, it is indicated that the bonded debt will be repaid well before the date of bond maturity in 1985.

The sale of bonds to the public, to banks, to the Reconstruction Finance Corp., and to insurance companies—and in fact every known means of financing—was explored by the Commissioners. The objective was not only to finance the project but to secure the best possible terms for the Authority.

The plan finally developed was on the "forward commitment" basis which would enable the Authority to obtain reliable commitments for the total financing, provide for the issuance of bonds and for the payment of interest as construction progressed and as the need for funds actually arose, and for the payment of a nominal standby fee on the remainder of the Authority's total requirements. Under this "commitment" plan as finally evolved, the bond issue was reduced from $230,000,000 to $220,000,000.

The forward commitment features of the plan also obviate the necessity of issuing bonds for some $18,000,000 of reserves for contingencies until, and only to the extent that, such reserves may be needed to complete construction. If such contingencies do not materialize, the total amount of the bond issue will be further reduced.

The plan involves commitments from a group of 52 institutional investors, mostly insurance companies, for the full amount of $220,000,000 at a standby fee of $\frac{1}{2}$ of 1 percent annually. As funds are needed for construction, the Authority will draw against these commitments, issuing its bonds for them. The definitive bonds will bear interest at the rate of $3\frac{1}{4}$ percent annually, and will be allocated on a predetermined basis to the subscribing institutions. The financing was completed and the first $10,000,000 block of bonds authorized on February 17, 1950.

In financing the turnpike, no taxpayers' money is used, and neither the faith nor the credit of the state, its counties or municipalities, is pledged. When the turnpike bonds are liquidated out of revenues, the highway will be turned over to the State Highway Department and become a part of the state highway system as required by law.

INTERCHANGE DESIGN for New Jersey Turnpike includes toll-booth structure so placed as to control all access and departure lanes. Entering and leaving at all of Turnpike's 16 interchanges is accomplished without left turns.

Turnpike Designed for High Speed

The turnpike has been divided into seven sections, and eight engineering firms of national reputation in the highway and bridge fields were selected on September 22, 1949, to do the design, prepare the contract plans, and supervise the construction. These firms are: (1) J. E. Greiner Co.; (2) Gannett Fleming Corddry & Carpenter, Inc.; (3) Parsons, Brinckerhoff, Hall & Macdonald; (4) DeLeuw, Cather & Co.; (5) Fay, Spofford & Thorndike; (6) Ammann & Whitney; (7) Edwards & Kelcey, Frederic R. Harris, Inc., O. J. Porter & Co., Associated; and (8) Howard, Needles, Tammen & Bergendoff, who also are general consultants to the Authority.

The design provides for a divided, grade-separated highway with fully controlled access. In the southerly 87-mile section, the topography is easy and with some exceptions the location is intensively developed farming country. Here the design speed is 75 miles per hour and the width of the median strip is 26 ft. Generally the minimum horizontal radius of curvature is 10,000 ft, but on some curves the radius goes up to 100,000 ft.

The northerly 30-mile section traverses a very heavily developed residential, commercial and industrial area with many intersecting highways, railroads, navigable streams and other improvements which complicate construction. The design speed here is 70 miles an hour generally, but in some difficult stretches vertical sight distance restricts the design speed to 60 miles an hour. Generally, the radius of horizontal curvature is in excess of 8,000 ft but in two places a 3,000-ft radius has been used. The median strip is generally 20 ft wide but in a 7-mile length it is widened to 94 ft.

From Deepwater for 92 miles to Route 35, north of the Raritan River, four lanes will be provided, and from Route 35 to the Lincoln Tunnel approach, six lanes (Fig. 1). The lanes will be 12 ft wide. In addition, there will be stabilized shoulders on each side of the travel lanes, 10 ft wide on the right or outside, and 5 ft wide on the left or inside. North of the Camden area all bridges passing overhead are being designed to accommodate future widening to six lanes to Route 35, and thence to the Lincoln Tunnel, provision is made for widening to an 8-lane dual-dual type.

Horizontal curves of 10,000-ft radius and sharper will be superelevated, and curves with a 3,500-ft radius and less will be spiraled. Maximum grades are limited to 3 percent and non-passing sight distances are established at 700 ft for 75 mph, 600 ft for 70 mph and 475 ft for 60 mph.

Several of the traffic interchanges will be expensive and will involve difficult design because of urban development, deep mud, traffic volumes and the necessity for eliminat-

CONSTRUCTION OF TURNPIKE is already under way on carefully worked out schedule to insure completion of all sections simultaneously late in 1951. Looking north from Belleville Turnpike toward Laurel Hill, in Hudson County, various types of equipment are seen doing grading and drainage work.

ing left turns onto existing connecting routes. Deceleration and acceleration lanes will be provided at interchanges and service areas. The minimum right-of-way width will be 300 ft from the Delaware River Memorial Bridge at Deepwater to the vicinity of the Raritan River, and 250 ft northward, except in heavily built-up areas where a 200-ft width is utilized for a limited distance.

About 240 structures will be required for the turnpike, consisting of bridges over streams, and highway-railway overpasses and underpasses. These structures will be designed to comply with AASHO H 20 - S 16 specifications as modified. The major bridges are over the Hackensack and Passaic Rivers although large structures are also required over the Raritan and Rahway Rivers and Rancocas Creek. There will be four viaducts of 1,000 ft and more in length.

Deck-Type Bridges Planned

The Hackensack and Passaic River Bridges will be of plate-girder design with 375-ft channel spans and a vertical clearance of 110 ft above high water. All bridges are planned to be of the deck type, without overhead steelwork to interfere with vision over the sides of the bridges. No unusual foundation problems are anticipated on any of the structures. The deepest foundations will be supported on steel piles up to 100 ft long, driven to bed rock or the equivalent, and protected from electrolysis and chemical soil action. There will be no movable bridges.

Generally underpasses, overpasses and viaducts will be of rolled steel beams supporting reinforced concrete roadway decks. The spacing of the beam flanges has been standardized to a large degree to facilitate re-use of deck forms. Bridge clearances over the turnpike will be 15 ft.

Service areas for the comfort and convenience of turnpike users will be provided with service stations for the sale of gasoline, oil, accessories and minor repairs, and restaurants to serve full course meals and snacks. All these facilities will be set well back from the travel lanes to avoid conflict with moving vehicles and to assure a quiet atmosphere for the traveler. Ample parking areas will be provided for service facilities.

Topography Simplifies Construction

Although the turnpike will traverse a large part of the length of New Jersey, the topography falls into only two categories. From the southerly end to Woodbridge, 93 miles, the country is gently rolling and highly favorable for highway location and construction except for some swamp areas. Throughout this distance there are no problems other than those generally associated with modern highway construction in populated areas. No rock work of any consequence is anticipated in the entire distance.

For the northerly 24 miles, much of the country is very low and flat and there are large areas of tidal flats and meadow marsh only slightly above sea level. Construction through the north Jersey meadows constitutes a major problem not only because of the soil stabilization required but also on account of the time element. The depth of the meadow mud, which varies from 10 to 100 ft, creates special problems in the building of embankments. Sand blanket materials must be placed and subsequent layers installed, allowing a sufficient time interval between the placing of each layer to prevent overloading and rupture of the soil structure.

Where embankments are over 10 ft high and the mud is deep, consolidation must be expedited in order to secure a stable roadway within the allotted time. Vertical sand drains are already being installed in the mud to assure rapid drainage and attain a firm support for the embankment. Construction of stable embankments in sufficient time to permit placing of pavement before the opening of the turnpike is mandatory.

In ordinary soils, before fills are placed, the existing ground is required to be consolidated for 1 ft to 90 percent of maximum density, AASHO modified. Bottoms of cuts are similarly treated to a depth of between 4 and 5 ft below the top of the pavement. In addition, all suitable materials in the cut are to be consolidated to 95 percent of maximum density, AASHO modified, to a depth of 4 ft, and the tops of all fills are to be similarly treated.

All fills are consolidated by controlled compaction and the top layers below the pavement subgrade are of selected frost-proof free-draining materials. To insure a frost-resistant subgrade capable of carrying heavy axle and wheel loads, the standard specifications require that the following types of selected material be placed in the subgrade beneath the assumed 18-in. depth of pavement and subbase.

1. In the upper 6 in. of the subgrade, Grade A subgrade material is to be used. This is a pervious, free-draining, frost-resistant material, classified as A3 in the Public Roads Administration (PRA) classification. This material must have a plasticity index of not more than 3, and be so graded that not more than 6 percent passes a 200-mesh sieve. When tested for bearing capacity, the material must have a California Bearing Ratio (CBR) of not less than 20 percent when compacted at 100 percent of maximum density.

2. For the remaining 12 in. of the subgrade, Grade B subgrade material is specified. This is frost-resistant material with a plasicity index of not more than 6, graded so that not more than 10 percent passes a 200-mesh sieve. When tested for bearing capacity, this material must have a CBR of not less than 15 percent when compacted at 100 percent of maximum density. Frost-resistant material is defined as a material such that not more than 10 percent passes a 200-mesh sieve and not more than 5 percent of the particles are less than 0.02 mm in size.

Completion Set for Late 1951

To maintain the schedule, construction will be accomplished during the working seasons of 1950 and 1951 by prequalified contractors awarded the work on the basis of competitive bids. Each contractor must finish his work in conformance with the predetermined schedule, which is set up so that the entire length of the turnpike can be opened to traffic simultaneously. There are 450 dwellings, stores and commercial plants within the right-of-way, which must be quickly removed to meet the fast construction schedule.

(*Continued on page 80*)

Engineers' Notebook

Engineer's Shortcut Solves Cubic and Higher Equations and Roots

D. B. STEINMAN, M. ASCE
Consulting Engineer, New York, N. Y.

A PRACTICAL "engineer's shortcut" whereby cubic and higher-degree equations can be speedily solved, and higher-degree roots (cube roots, fifth roots, seventh roots, etc.) of given numbers can be easily extracted, in each case to any desired degree of accuracy, has been developed by the writer and is here presented.

Solution of Equations

First, the method for solution of equations is explained directly by the use of numerical examples.

Example 1—Cubic Equation

$$x^3 = 5x^2 + 2x + 3$$

	5	25	135	740 ...
		2	10	54 ...
			3	15 ...
$r =$	5	27	148	809 ...

$$x = \frac{809}{148} = 5.466$$

The coefficient of x^3 is unity. The other given numerical coefficients (5, 2, 3) are written diagonally across the rows and columns. The rows are written by multiplying the coefficient heading each row by the sequence of values of r, as these values become available. The values of r are written by adding the terms in each respective column.

The values of r are the successive approximations to x, x^2, x^3, x^4, etc. Consequently the successive approximations to x are given by the converging ratios:

$$x \backsimeq \frac{5}{1}, \frac{27}{5}, \frac{148}{27}, \frac{809}{148}, \ldots$$

or $x \backsimeq 5, 5.4, 5.48, 5.466, \ldots$

Stopping the computation at this point gives the answer correct to four significant figures.

Example 2—Quartic Equation

$$x^4 = 5x^3 + 2$$

	5	25	125	625	...
				2	...
$r =$	5	25	125	627	...

$$x = \frac{627}{125} = 5.016$$

In this example, the coefficients of x^2 and x are zero. The corresponding rows are therefore omitted from the tabulation. The calculation is reduced to the ultimate in simplicity.

Example 3—Quintic Equation

$$x^5 = 10x^4 + x^3 + 2x^2 + 3x + 4$$

	10	100	1010	10220	103440	...
		1	10	101	1022	...
			2	20	202	...
				3	30	...
					4	...
$r =$	10	101	1022	10344	104698	...

$$x = \frac{104{,}698}{10{,}344} = 10.1216$$

Simple arithmetic thus gives the answer correct to six significant figures.

Special Case of Unit Coefficients

The application can be further simplified in special cases. Thus, if all the coefficients in the expression for x^n are unity, the tabulation may be omitted, and the values of r may be written directly as a simple sequence in which each term is equal to the sum of the n preceding terms.

Example 4—Quartic Equation

$$x^4 = x^3 + x^2 + x + 1$$

$r = 1, 1, 2, 4, 8, 15, 29, 56, 108, \ldots$

$$x = \frac{108}{56} = 1.928$$

In this case, all the coefficients in the expression for x^4 are unity. Accordingly, the values of r are written directly as a simple sequence in which each term is the sum of the *four* preceding terms (since the equation is of the *fourth* degree). In fact, any sequence written by this rule would converge to the same value of x, even if random numbers were used for the initial values of r. The method is self-correcting.

Non-Converging Case

In all the foregoing examples, the absolute values of x were greater than unity—the necessary condition for convergence. If the absolute value of x is less than unity, substitute $y = 1/x$, by simply reversing the equation.

Example 5—Cubic Equation

$$x^3 = 2x^2 - 5x + 1$$

$$\text{Let } x = \frac{1}{y}$$

$$y^3 = 5y^2 - 2y + 1$$

	5	25	115	...
		−2	−10	...
			1	...
$r =$	5	23	106	...

$$x = \frac{1}{y} = \frac{23}{106} = 0.217$$

The transformed equation has the same numerical coefficients as the given equation, but *in reverse order* (with signs changed by transposition). Since the solution requires $1/y$, the *inverse* r-ratios are used to give the reciprocal.

Non-Unit Coefficient

If the term of highest degree is mx^n instead of x^n, it is not necessary to divide all of the coefficients by m before applying the foregoing procedure. Instead, the summation of each column is divided by m to obtain r.

Example 6—Cubic Equation

$$1.2x^3 = 6x^2 - x + 4$$

		6	30	145	...
$(m = 1.2)$			**−1**	−5	...
				4	...
$mr =$		6	29	144	...
$r =$		5	24.17	120	

$$x = \frac{120}{24.17} = 4.97$$

In this case, $m = 1.2$. The summations mr are divided by 1.2 to give the values of r, which are used as the multipliers for the succeeding columns.

Method of Speeding Convergence

To expedite convergence, start with $r = 1, x_0, x_0^2, \ldots$, where x_0 is an approximate trial root.

Example 7—Cubic Equation

$$x^3 = 3x^2 + 4x - 1$$

	3		48	189	...
		4	16	64	...
		−1	−1	−4	...
r =	1	4	16	63	249 ...

$$x = \frac{249}{63} = 3.95$$

The trial root is $x_0 = 4$; hence 1, 4 16, are used as the first three values of r. By this shortcut, the number of steps is reduced, and the answer (of any desired accuracy) is reached with smaller numbers in the calculation.

To Find the nth Root of a Given Number

To solve the equation $x^n = N$, transform the equation to supply the missing terms and then solve by the foregoing method of convergents. A convenient transformation is $x = a \pm 1/y$, where a is an approximate root, usually the nearest integer to the required root.

Example 8—Square Root

To solve: $x^2 = 7(= 3^2 - 2)$

Let: $x = 3 - \frac{1}{y}$; $y^2 = 3y - \frac{1}{2}$

	3	9	25.5	...
		−0.5	−1.5	...
r =	3	8.5	24	...

$$x = 3 - \frac{8.5}{24} = 2{:}6458$$

This solution, to five significant figures, is actually speedier than the conventional method of extracting square roots, uses smaller numbers, and gives the answer by slide rule. For roots of higher degree, the classical method is completely eclipsed.

Example 9—Cube Root

To solve: $x^3 = 67(= 4^3 + 3)$

Let $x = 4 + \frac{1}{y}$; $y^3 = 16y^2 + 4y + \frac{1}{3}$

	16	256	...
		4	...
			1/3
r =	16	260	...

$$x = 4 + \frac{16}{260} = 4.0615$$

The actual numerical work in this solution, giving the answer (by simple mental arithmetic) to five significant figures, can hardly be matched for brevity.

Example 10—Fifth Root

To solve: $x^5 = 37(= 2^5 + 5)$

Let $x = 2 + \frac{1}{y}$

$$y^5 = 16y^4 + 16y^3 + 8y^2 + 2y + \frac{1}{5}$$

	16	256	4352	...
		16	256	...
			8	...
				2 ...
r =	16	272	4616	...

$$x = 2 + \frac{272}{4{,}616} = 2.0589$$

The answer is speedily obtained to five significant figures without going beyond the third coefficient.

Method Is Quick and Simple

For the solution of cubic and higher-degree equations, and for the extraction of cube roots and higher roots of given numbers (without the use of tables), the shortcut method here presented should commend itself to engineers for its speed and simplicity. The actual numerical operation has been reduced to a seemingly irreducible minimum.

...THE READERS Write

St. Lawrence Project Power Needed

TO THE EDITOR: The article by Mr. Murrow on the St. Lawrence Seaway in the March 1950 issue contains statements which should be corrected. His statement on the "alleged power shortage" is in direct contradiction to statements issued by the largest electric utility in upstate New York. A report of Ebasco Services, Inc., filed with SEC by Niagara Hudson Power Corp., March 2, 1949, states:

"In no other major utility east of the Mississippi River and north of the Mason and Dixon Line did the war leave so severe a deficiency of power facilities . . . . Postwar Niagara Hudson has been left seriously short of capacity, has been using its standby and peak-load steam plants to carry regular load at high unit costs, and has been heavily dependent upon the uncertain assistance obtainable by purchasing the output of marginal high-cost steam reserve units of its neighbors."

The aluminum plants built by Defense Plants Corp. at Massena, N.Y., and at Maspeth in New York City were dependent upon power generated from coal-burning steam plants. Massena had the highest power cost of any D.P.C. unit, 6.3 to 7.3 cents per lb of aluminum produced, with Maspeth power costs ranging from 5.5 to 6.0 cents per lb. Both plants produced aluminum at an average direct operating cost of about 15.5 cents per lb, as compared with a cost of 10 or 11 cents in plants supplied by hydro power. Small wonder that both plants were closed down early in 1944 after 15 to 18 months of operation. The scheduled production of the Massena plant was reduced from 150,000,000 to 96,000,000 lb of aluminum production capacity a year on the ground that sufficient power was not available at Massena to supply the scheduled production at a higher level. Alcoa, in February 1949, shut down its Niagara Falls smelting works (with a production capacity of 40,000,000 lb per year) because electric power was no longer available.

The Federal Power Commission in its September 1949 report on the St. Lawrence Project gave 700,000 kw as the dependable capacity and not 570,000 kw, as given by Mr. Murrow. The estimated average annual energy output (New York plant only) of the St. Lawrence Project was given as 6.28 billion kwhr, or over 23 percent of the total production of electric energy of 27.2 billion kwhr in New York State contributing to the public supply in 1948.

The cost of transmission facilities for delivery of St. Lawrence Project output to load centers in New York State was estimated by S. E. Schultz, Chief Engineer, Bonneville Power Administration, while serving as engineer-consultant to the Power Authority of the State of New York in 1948, at $59,000,000. Considering that the cost of all transmission facilities owned by electric utilities in New York State in 1948 had a book value of $179,000,000, the statement by Mr. Murrow that "such a transmission system easily might involve capital costs exceeding those for the power plant itself," does not carry much weight.

Mr. Murrow implies that Consolidated Edison's 2,800,000 kw of capacity within New York City, or Niagara Mohawk's 625,000-kw Huntley Plant near Buffalo, or the proposed 1,320,000-kw installation for the Niagara River redevelopment somehow would be immune to A-bomb or H-bomb attacks.

If Mr. Murrow examines the Power Authority Act he would see that the "risk" of financing New York's share of

the St. Lawrence Power Project will not be "carried by the public treasury." Section 1005 of the Act expressly provides that the Authority "shall have no power at any time to pledge the credit of the State nor shall any of its obligations or securities be deemed to be obligations of the State...." It was further declared as the object of the Act that "the project should be in all respects self-supporting."

In reference to St. Lawrence vs. Niagara power costs, the Power Authority in its Annual Report for 1949 has pointed out that "the at-site cost of St. Lawrence Project energy will range from 0.9 percent greater to 35.9 percent less than at-site Niagara redevelopment energy, depending upon the final scheme used in each case."

Considering the most costly scheme in each case, St. Lawrence is cheaper than Niagara by $25 per kw, as follows:

	New York-Ontario St. Lawrence Project	Niagara Redevelopment Project (Tunnels)
Estimated cost	$451,615,000	$350,300,000
Installed capacity, kw	1,881,000	1,320,000
Dollars per kw	240	265

The estimated delivered cost of St. Lawrence Project energy is less than one-half the estimated delivered cost of comparable energy from modern coal-burning generating plants, which private utilities would be required to build to meet future demands if the St. Lawrence Project is not developed. The more than 4,500,000 customers for electric service in New York State should no longer be denied the use of this low-cost hydroelectric energy.

IVAN SATTEM, Assoc. M. ASCE
Head Engineer and Acting Executive Secretary, The Power Authority of the State of New York
New York, N.Y.

St. Lawrence Seaway Project Is Endorsed

TO THE EDITOR: In his article on the St. Lawrence Seaway in the March issue, Gen. Lacey V. Murrow made statements which might convey erroneous impressions.

Engineers do not all recognize the probability that the actual cost of a project of the magnitude of the St. Lawrence Seaway will vastly exceed present estimates. The comparison of estimated and actual costs of similar projects in Table I of General Murrow's statement requires further examination. While I am not familiar with all the projects in the table, I do know that the actual cost of some of them included much more work of a greater scope than was contemplated in the original project. Many such projects, once undertaken, expand in scope. This does not mean that the actual cost has exceeded that estimated. It does mean that more work was done for greater service.

General Murrow's statement that it would be several years before definite information is available on the Labrador ore situation does not check with the fact that a work road has already been built for a distance of 60 miles north from Seven Islands on the St. Lawrence River and that equipment for building the necessary railroad is now being shipped in by plane and by tractor train. Present plans call for ten contractors to build this 360-mile railroad in sections and to complete the job in two years. It is then expected that at least 10,000,000 tons of ore, equal to or better than that from the Mesabi Range, will be mined in a six-months' season. Six steel companies in the United States associated with the Hollinger interests in Canada are undertaking this project.

As for shipping accommodations, Capt. Edward McCauley of the U.S. Maritime Commission says that 80 percent of our shipping could use the proposed seaway. W. W. Huggett of the North Pier Terminal Co. of Chicago states that 85 percent of all freighters could use the proposed seaway. The St. Lawrence Seaway would be no more detrimental to our merchant fleet than our seaboard ports are.

The St. Lawrence is now closed 37 percent of the year. Notwithstanding winter conditions, the present tonnage on the Great Lakes is greater than on the eastern seacoast and the Gulf coast combined.

It is quite possible that all military men do not agree as to what is most essential for our country's defense. However, on May 28, 1945, when he was Secretary of State, Gen. George Marshall, former Chief of Staff of the U.S. Army, strongly endorsed the Great Lakes–St. Lawrence Seaway and Power Project for military reasons. The Joint Chiefs of Staff supported Secretary Marshall as did the Permanent Joint Board on Defense for the United States and Canada.

WILLIAM T. FIELD, M. ASCE
Field, Emerson & Morgan, Inc.
Watertown, N.Y.

Broad Definition of Sanitary Engineering Advocated

TO THE EDITOR: The February 1950 issue of CIVIL ENGINEERING carried the résumé of a paper given at the recent annual meeting by Franklin Thomas, Past President of ASCE, and Dean of Students, California Institute of Technology, entitled "Sanitary Engineers Face Problems Incident to Rapid Expansion in Field of Sanitation." While the printed résumé may not do justice to the paper as it was presented, it raises questions as to the position of the sanitary engineer within the ASCE, who should be classed as a sanitary engineer, and what type of education and training are best suited for the sanitary engineer. There follow the flat statements that, while sanitary engineers may become involved in the fields of public health engineering, environmental sanitation, and industrial hygiene, "it does not follow that all who are engaged in these fields should be considered as sanitary engineers," and that "the terms 'public health engineer' and 'public health engineering' should be abolished."

With respect to the first quoted statements, it is quite obvious that chemists, bacteriologists, veterinarians, and others variously educated and trained who are employed in industrial hygiene or environmental sanitation work are not engineers regardless of the technical or administrative work they may be performing. Therefore, to those sanitary engineers long engaged in these activities, the alternative inference that engineers so employed have somehow disqualified themselves professionally comes as a rude shock to their conviction that the application of engineering principles and training to the control of the environment is sanitary engineering.

To get back to fundamentals, the ASCE has long represented the great body of engineers primarily concerned with designing and building structures. Historically, sanitary engineers have been civil engineers engaged in building structures and in modifying and controlling the physical environment for the purpose of benefiting public health. To conceive of the sanitary engineer only as one who designs a water supply system or a sewage collection and treatment works is to ignore the fact that the modern community is itself a complex *structure* in which many factors other than water and sewage demand the application of engineering principles and management.

Whether the sanitary engineer is concerned with the total environment of concentrated populations ranging from 50,000 to 7,000,000, or with the working environment of large numbers of industrial employees in many factories, it is one of his functions to apply his engineering training and his knowledge of the necessities of public health to the maintenance of physical order and to the prevention of physical disorder in such aggregates of population. Since the engineer is best prepared by engineering disciplines to deal with the physical environment, it should follow that control and modification of the physical environment in the interest of public health (environmental sanitation) can best be planned and directed by the engineer, although he may

properly be aided by a variety of other persons with special educations and skills adapted to particular tasks and problems.

Surely it is within the professional province of the sanitary engineer to be concerned with problems of community planning, with air pollution, with the cleaning of cities of their debris, with the sanitary aspects of the production, mechanical processing, and preservation of milk and other foods, with the prevention of malaria, typhus, and plague, with housing and the control of large realty developments, with recreational facilities, and with the vast problems of radioactivity. A whole series of reports of the Sanitary Engineering Division have recognized the expansion of this field and have pointed to the sanitary engineer's professional responsibility therein. (H. P. Eddy, PROCEEDINGS, January 1924; Reports, Committee on Advancement of Sanitary Engineering, PROCEEDINGS, June 1942, p. 965; May 1946, p. 647; June 1949, p. 795.)

Can it be argued that a sanitary engineer, who is officially employed in any of the above activities and using, for convenience of classification, the common civil service title of public health engineer or industrial hygiene engineer, thereby ceases to use his engineering education and training, stops being a sanitary engineer, and cuts himself off from his professional associates who may call themselves hydraulic engineers, construction engineers, highway engineers, bridge engineers, city planning engineers, or professors of engineering?

Because of the complexities and ramifications of sanitary engineering as it is now actually practiced, many sanitary engineers and educators have come to the conclusion that, to the basic civil engineering course of four years, there must be added a fifth, and even a sixth year of specialization for one to be truly qualified educationally as a sanitary engineer so that he may thereafter become competent through experience for those tasks best performed by a sanitary engineer.

In the judgment of the undersigned, the Society should recognize more fully the broadened professional services some of its members are now rendering rather than to exclude, through indifference or misunderstanding, a traditional civil engineering function, long a distinguished part of the Society's contributions to the welfare of mankind.

HERMAN G. BAITY, M. ASCE
Professor of Sanitary Engineering, University of North Carolina

J. LLOYD BARRON, M. ASCE
Sanitary Engineer, National Biscuit Co.

EARL DEVENDORF, ASSOC. M. ASCE
Director, Bureau of Environmental Sanitation, New York State Department of Health

HERBERT J. DUNSMORE, ASSOC. M. ASCE
Director, Division of Sanitation, Pittsburgh Department of Health

JOHN M. HENDERSON, M. ASCE
Professor of Sanitary Science, Columbia University

ARTHUR H. HERBERGER, ASSOC. M. ASCE
Director, Division of Sanitation, Nassau County (N.Y.) Department of Health

MARK D. HOLLIS, M. ASCE
Assistant Surgeon General, U.S. Public Health Service

WILLIAM T. INGRAM, ASSOC. M. ASCE
Associate Professor of Public Health Engineering, New York University

SOL PINCUS, M. ASCE
Consulting Sanitary Engineer, New York, N.Y.

CHARLES L. SENN, ASSOC. M. ASCE
Engineer-Director, Bureau of Sanitation, Los Angeles Department of Health

ABEL WOLMAN, M. ASCE
Professor of Sanitary Engineering, Johns Hopkins University

Author Thomas Replies

TO THE EDITOR: In the foregoing communication to CIVIL ENGINEERING, subscribed to by eminent men in the sanitary engineering field, it is believed that exception is taken to an implication which was neither expressed nor intended. No statement was made that limited the sanitary engineer "only as one who designs a water supply system or a sewage collection and treatment works." Of course, in the broadening application of pure and applied science to human betterment, it is natural for the qualifications and interests of sanitary engineers to be utilized in environmental sanitation and industrial hygiene. In so applying their abilities to these areas of expanded activities, engineers surely have not "disqualified themselves professionally."

The designation "Sanitary Engineer" is sufficiently comprehensive to identify those engineers who work in the more recent extensions of activity of the field as well as those concerned closely with the problems of water supply and sewerage. The designation "Engineer" should not be perverted or diluted by permitting its use by those lacking the competence represented by the professional engineer status. It is doubted, though, if the professional status is enhanced by encouraging *titles* representing excessive subdivision of the civil engineering field.

FRANKLIN THOMAS, Past President, ASCE
Professor of Civil Engineering, California Inst. of Technology
Pasadena, Calif.

Common Sense May Favor Cooling of Dam Concrete

TO THE EDITOR: The thought in Ross White's short discussion, "Common Sense Can Promote Economy in Dam Construction," in the February issue, is highly commendable. Every engineer concerned with any of the phases of design, preparation of specifications, or construction of a dam would do well to consider the practices and requirements mentioned by Mr. White and many similar conditions from the standpoint of common sense, before including them in a solution. But as serious a mistake can be made by considering that such practices are unnecessary in every instance. General condemnation of the practices mentioned by Mr. White is likely to lead to non-common-sense solutions.

An example is his criticism of the practice of cooling concrete in dams. He states:

> "This practice is especially open to question in the case of structures which in size and character are in no way out of the ordinary. The cost of such refrigeration is not trivial; it may increase the cost of a large modern dam by millions of dollars."

Costs compiled by the Bureau of Reclamation show that all costs that might be chargeable to cooling, which include costs of furnishing and installing all embedded material, construction and operation of cooling plant, and performance of all work specified in connection with cooling, have in none of the 13 cases in which cooling was specified by the Bureau exceeded $1 per cu yd for the cooled concrete. These costs during the past 15 years have varied with the size of the job and with construction costs in general, as shown in Table I.

When Mr. White stated that cooling costs amount to millions of dollars, he could only have had in mind Hungry Horse, Grand Coulee, and Shasta Dams; not even Hoover Dam would qualify. And these are indeed large, modern dams.

TABLE I. COOLING COSTS FOR VARIOUS DAMS

DAM	YEAR	VOLUME COOLED, CU YD	COST PER CU YD	TOTAL COST
Hoover	1931	3,288,000	0.25	$ 822,000
Parker	1934	291,000	0.20	58,200
Seminoe	1935	176,000	0.33	58,080
Grand Coulee (1)	1935	4,237,000	0.13	1,559,710
(2)	1937	5,605,000	0.18	
Shasta	1938	6,015,000	0.21	1,263,150
Friant	1939	2,022,000	0.30	606,600
Marshall Ford (enlargement)	1940	656,000	0.55	360,800
Keswick	1941	71,600	0.64	45,824
Davis	1945	240,000	0.90	216,000
Kortes	1946	82,000	0.43*	35,260
Angostura	1946	170,000	1.00*	170,000
Hungry Horse	1948	2,930,000	0.68*	1,992,400
Canyon Ferry	1949	360,000	0.77*	277,200

* Estimated from contractors' bids.

not dams "in no way out of the ordinary."

It may be argued, of course, that direct costs are not the only costs of cooling; that there are hidden costs reflected in increased bids for other work which may be made more expensive by reason of cooling requirements, such as cleanup of the top of the lift, placement of concrete, and handling of forms. By the same token it may be shown that with cooling, less expensive construction may be incorporated in the design. For example, without temperature control as provided, contraction joints in both directions in Hungry Horse Dam would have had to be spaced much closer together to avert serious cracking. It was estimated that $0.50 a cu yd in form costs alone was saved through the increased block size made possible by cooling the concrete. It is reasonable to expect that this saving would be reflected in lower unit prices for placing concrete.

Unless the concrete were cooled, or contraction joints were spaced very close together, or some other more costly procedure were incorporated in the design, it is likely that a continuous open crack would be formed parallel to the axis of a 400-ft-high straight gravity dam, thus splitting the dam longitudinally into two pieces.

The very conditions considered desirable from the viewpoint of economy in construction, such as rapid placement, most economical methods of handling materials, no construction or contraction joints, are chiefly responsible for the increased attention that needs to be paid to such factors as temperature control, segregation, and specification of allowable procedures to produce the desired end result. Common sense is necessary all along the line.

Neither contractors nor engineers would advocate a failure or two just to be certain that dams are designed and constructed as close as possible to the edge of the margin of safety.

CLARENCE RAWHAUSER,
Assoc. M. ASCE, *Engineer,*
Denver, Colo. *Bureau of Reclamation*

Defends Conclusions on Rio Grande Sediment

TO THE EDITOR: In the May issue, page 39, Thomas Maddock, Jr., discusses my article, "Aggradation in Rio Grande Valley Affects Sedimentation of Elephant Butte Reservoir," which appeared in the February issue.

Mr. Maddock finds two errors in my article. Let's examine them.

1. It is true that the deposits of 1936–1941 in the valley floor are not concurrent with those in the Elephant Butte Reservoir 1915–1947, but Mr. Happ states plainly, page 1192: "... comparisons of water-surface elevations indicate river aggradation from 1917 to 1937 at about the same rate as the 1936–1941 floodway aggradation." I was therefore fully justified in using the average annual deposition in the valley 1936–1941 as that for the entire period of record for Elephant Butte Reservoir. This might not apply to measurements of suspended sediments but represents sediments that did not pass into the reservoir; it is aggrading the floodway at a rate of about 1 ft in 12 years (Happ).

The total sediment deposited in the Rio Grande Valley and reservoir averages 1.8 acre-ft per year per sq mile of drainage area. This is 2,550 tons per sq mile per year at a specific weight of 65 lb. This should be compared with Mr. Maddock's estimate of only 800 tons for the 1,747 sq miles directly tributary to the reservoir. He may be right; the sediments are not uniformly distributed.

2. I did not bother to deduct the deposit above Cochiti since it amounts to only 15 acre-ft per year, or about 1 per thousand and is an entirely negligible quantity. It does not affect my final conclusions in the slightest degree.

Mr. Maddock objects to my last paragraph—a prophecy. There is however ample geological proof of a number of periods of aggradation and subsequent degradation in every valley of the Southwest. These immutable laws of nature cannot be repealed in such an off-hand manner; what man has done may affect the time of its occurrence slightly but not the final outcome. It may be that degradation of the Rio Grande Valley may not occur until Elephant Butte Reservoir has been filled with sediment, but it is only a question of time.

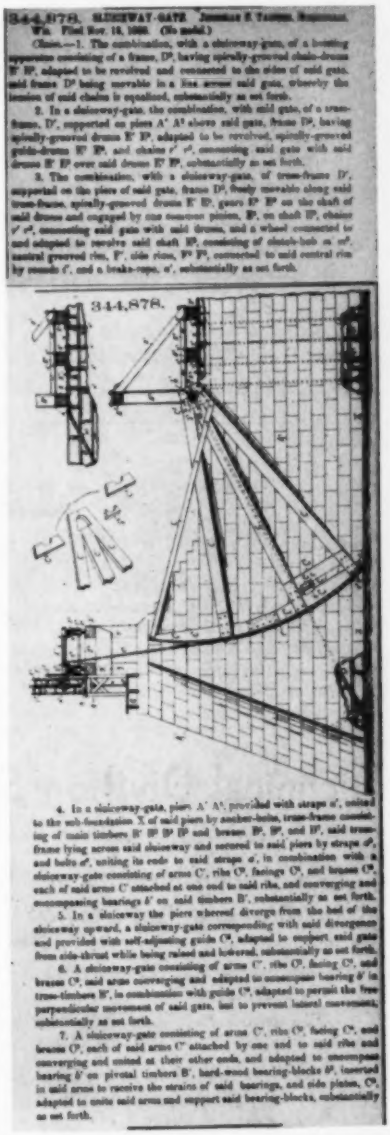
J. C. STEVENS, M. ASCE
Stevens & Koon, Engineers
Portland, Ore.

Patent Office Record on Tainter Gate Cited

TO THE EDITOR: Mr. Streiff's interesting story in the March issue, page 29, on a record-size radial gate installed in Spain, together with the publication of the second edition of a very excellent hydroelectric handbook, once again brings to our attention the spelling of the word "Tainter." Mr. Streiff uses the spelling "Tainter," while the handbook uses "Taintor"—as it also did in the first edition, 1927.

Since many engineers still prefer to use the word "Tainter" instead of the more modern "radial," we have looked up the patent reports in the *Official Gazette of the United States Patent Office.* We found that the handbook spelling is wrong, and that some of Mr. Streiff's data do not check with the recorded patent information. The following data are presented to get the record straight.

Application for patent No. 344,878 was made on November 16, 1885, by Jeremiah B. Tainter, Menomonee, Wis.


344,878.

PHOTOSTAT FROM *Official Gazette of the United States Patent Office* (v. 36, pp. 21–22, July 6, 1886) shows drawing and description of Tainter gate for patent No. 344,878, awarded to Jeremiah B. Tainter, presumably on that date.

The record appears in the listing for July 6, 1886, so that is presumed to be the date when Mr. Tainter actually obtained his patent.

A photostatic copy of the above data is attached for your information and files.

DON H. MATTERN, M. ASCE
Knoxville, Tenn.

Joint Summer Convention

American Society of Civil Engineers—Engineering Institute of Canada

Toronto, Ontario, Canada **July 12–14, 1950** **Hotel Royal York**

64th Annual Meeting of Engineering Institute of Canada—Summer Convention of American Society of Civil Engineers
Registration: Hotel Royal York, opens 2:00 p.m., Tuesday, July 11; July 12–14 inclusive from 9:00 a.m. to 5:00 p.m.
Registration fee (except ladies and students) $3.00
Ticket information and reservations for all events may be obtained at registration desk.

EIC Annual Business Meeting

Wednesday 10:00 a.m.
CONCERT HALL, HOTEL ROYAL YORK

Committee and Branch Report
Treasurer's Report
Election of Officers
Amendments to By-Laws
Address of the Retiring President

Authors' Breakfasts

PARLOR 8 HOTEL ROYAL YORK
Wednesday Morning, July 12, 1950, 8:00 a.m.
Thursday Morning, July 13
Friday Morning, July 14

For all speakers, presiding officers, prepared discussers and program officials on each day's program.

ASCE General Business Meeting

Wednesday 10:30 a.m.
BALLROOM, HOTEL ROYAL YORK

A session for transaction of official Society business by the membership. President Ernest E. Howard, presiding, will present the Annual Presidential Address.

Joint Membership Luncheon

Wednesday, July 12, 12:15 p.m., Banquet Hall, Hotel Royal York

Welcome to Toronto by HIRMAN E. MCCALLUM, Mayor of Toronto
Response by EIC President JOHN E. ARMSTRONG
Response by ASCE President ERNEST E. HOWARD
Toastmaster for the occasion: E. ROSS GRAYDON
Address by Wesley W. Horner, Past President of ASCE; Chairman, Engineers' Joint Council Committee on National Water Policy

More Effective Utilization of Water Resources

In this address by Mr. Horner, the work of Engineers' Joint Council's National Water Policy Committee will be related, an activity of concern to all engineers.

All members of both organizations, their ladies, guests and friends are cordially invited to attend this luncheon and enjoy the opportunity of sharing Mr. Horner's thought-provoking address. Per plate $2.50.

Technical Division Sessions—Wednesday Afternoon, July 12

All Division Sessions have been arranged and will be conducted as joint projects of EIC and ASCE

Engineering Institute of Canada, Technical Session

2:00 P.M. **BALL ROOM**

2:00 Electronics and Surveying Shoran in Triangulation

J. L. RANNIE, M. EIC, Department of Mines and Technical Surveys, Ottawa.

3:00 Radar Altimeter in Leveling

S. JOWITT, Department of Mines and Technical Surveys, Ottawa, Ontario.

4:00 Development of the Automatic Automobile Transmission

H. E. CHURCHILL, Director of Research, Studebaker Corp., South Bend, Ind.

Power Division

2:00 P.M. **PARLOR 9**

Presiding: Milton G. Salzman, M. ASCE; Chairman, Executive Committee, Power Division

2:00 Report of Subcommittee on Ice Pressure

OPENING REMARKS:

R. L. HEARN, M. ASCE; Chairman of Committee; General Mgr. and Chief Engineer, Hydroelectric Power Commission of Ontario, Toronto, Ontario.

PAPER:

ROBERT F. LEGGET, M. ASCE; Vice-Chairman of Committee; Director, Division of Building Research, National Research Council, Ottawa, Ontario.

3:30 Engineering Aspects of the Ottawa River Developments

J. R. MONTAGUE, Director of Engineering, Hydroelectric Power Commission of Ontario, Toronto, Ontario.

Air Transport Division

2:00 P.M. **PARLOR 10**

Presiding: Herbert H. Howell, M. ASCE, Member, Executive Committee, Air Transport Division, and J. C. Finlayson, M. EIC, Air Transport Board, Ottawa, Ontario

2:00 Flexible Pavement Design for Airport Runways

NORMAN W. MCLEOD, Engineering Consultant, Canadian Department of Transport, Ottawa, Ontario.

2:45 The Effect of Modern Electronic Navigational Devices on International Airport Design

JOSEPH D. BLATT, Assoc. M. ASCE; Chief, Planning Staff Division, Office of Federal Airways, Washington, D.C.

3:30 New Developments on the Design and Construction of International Airports

O. J. PORTER, M. ASCE; Chief Engineer, O. J. Porter & Co., Sacramento, Calif., and Newark, N.J.

Soil Mechanics and Foundations Division

2:00 P.M. **TUDOR ROOM**

Presiding: Philip C. Rutledge, Assoc. M. ASCE, Chairman, Executive Committee, Soil Mechanics and Foundations Division, and R. M. Hardy, M. EIC, Assoc. M. ASCE, Dean of Engineering, University of Alberta

2:00 Engineering Studies for South Saskatchewan River Dam

2:30 Foundation for British Columbia Project of the Aluminum Company of America

3:00 Final Foundation Treatment for Hoover Dam

A. W. SIMONDS, M. ASCE; U.S. Bureau of Reclamation, Denver Federal Center, Denver, Colo.

3:30 Foundations in Silty Soils

Waterways Division

2:00 P.M. **PARLOR 8**

Presiding: Glen E. Edgerton, M. ASCE, Chairman, Executive Committee, Waterways Division

2:00 Development of Structures to Meet the Needs of Navigation, St. Marys Falls Canal (Soo Locks)

THOMAS C. TRELFA, Civil Engineer, Chief, Engineering, Construction and Operations Division, Detroit District, Corps of Engineers, Detroit, Mich.; and C. S. MILLER, Civil Engineer, Chief, Lock Operations Branch, Sault Ste. Marie Suboffice, Sault Ste. Marie, Mich.

3:00 General Aspects of Waterway Traffic on the Great Lakes

JOHN R. HARDIN, M. ASCE; Colonel, Corps of Engineers, Division Engineer, Great Lakes Division, Chicago, Ill.

Joint Banquet

Wednesday, July 12

BANQUET HALL HOTEL ROYAL YORK

6:30 Cocktails and reception

7:30 Dinner

9:30 Harvey Perrin Choir

This outstanding chorus will present a concert of best-loved music. Informal dress. $4.00 per plate.

Technical Division Sessions—Thursday Morning, July 13

Engineering Institute of Canada, Technical Session

9:30 A.M. **PARLOR 9**

9:30 Diesel Electric Traction on the Canadian National Railways

P. L. MATHEWSON, Transportation Engineer, Canadian National Railways, Montreal.

10:30 Design of Antennas for High-Speed Aircraft

W. A. CUMMING, Radio and Electric Engineering Division, National Research Council, Ottawa, Ontario.

Construction–Power Divisions, Joint Session

9:30 A.M. **BALLROOM**

Presiding: Milton G. Salzman, M. ASCE, Chairman, Executive Committee, Power Division, and Hal W. Hunt, M. ASCE, Chairman, Program, Construction Division

9:30 Placing of Concrete in Winter

R. B. YOUNG, M. EIC: Assistant Director of Research, and GORDON MITCHELL, M. EIC; Construction Engineer, Hydroelectric Power Commission of Ontario.

10:30 Construction of Mt. Morris Dam

W. V. GREELEY, M. ASCE; Project Manager, Mt. Morris Dam Constructors, Inc., Genessee River, New York.

11:15 Dry Ice Used to Stop Water Flow

A. J. S. TAUNTON, M. EIC; Deputy Chief Engineer, City of Winnipeg.

Men's Membership Luncheon

Thursday, July 13

12:30 P.M. **BANQUET HALL**

The informal luncheon on Thursday will provide an opportunity for meeting old friends and making new acquaintances. All members, guests and friends of EIC and ASCE are cordially invited to attend.

No speakers. $2.50 per plate.

Waterways Division

9:30 A.M. **PARLOR 10**

Presiding: Glen E. Edgerton, M. ASCE, Chairman, Executive Committee, Waterways Division

9:30 Crustal Movement of the Earth's Surface in the Great Lakes Area

SHERMAN MOORE, Engineering Consultant, U.S. Lake Survey, Corps of Engineers, U.S. Army.

10:15 Phenomena of Lake Levels of the Great Lakes

LOUIS D. KIRSHNER, Assistant Chief, Engineering Operations Branch, U.S. Lake Survey, Corps of Engineers, U.S. Army.

11:00 Beach Erosion Problems of the Presque Isle Peninsula, Erie, Pa.

FRANK H. FORNEY, M. ASCE, Colonel, Corps of Engineers; District Engineer, Buffalo District, Buffalo, N.Y., and GERALD A. LYNDE, Civil Engineer; Chief, Beach Erosion Section, Buffalo District, Buffalo, N.Y.

Thursday Afternoon, July 13

Construction Division

2:00 P.M. **BALLROOM**

Presiding: F. G. Rutley, M. EIC, Vice-President, The Foundation Company of Canada, Inc., Montreal, Canada

2:00 Construction Planning and Execution for Rapid Transit in Toronto

W. H. PATERSON, M. ASCE; Chief Engineer, Toronto Transportation Commission.

2:30 Construction Problems and Methods of the Toronto Subway

CHARLES B. MOLINEAUX, M. ASCE; General Manager, Pitts, Johnson, Drake and Perini, Contractors, Toronto, Ontario.

Immediately following this paper, an inspection tour of subway construction will be conducted by the contractors, Pitts, Johnson, Drake and Perini. This work is in the area immediately adjacent to the headquarters hotel, so that no transportation will be required.

Excursion to Niagara Falls

Thursday Afternoon **2:00 P.M.**

Leave Hotel Royal York 2:00 p.m. for trip to Niagara Falls.

Transportation both ways will be provided.

Supper will be served at the Falls, with the return trip in the evening.

Ladies Program

TO THE LADIES:

The Ladies Committee of the Toronto Branch looks forward to welcoming a large group of Canadian and American friends.

The arrangements of the ladies program will permit you to take part in all the official functions of the Convention with your husbands. In addition, other affairs have been specially planned for you. Throughout the Convention, a ladies headquarters will be maintained in the Library of the headquarters hotel, the Royal York.

On Wednesday afternoon there will be a tea and fashion show. On Thursday afternoon and evening, it is hoped you will participate in the non-technical events which the men's committees have arranged.

Transportation will be available at all times for sightseeing and shopping tours.

The Committee hopes to see you in July.

Technical Division Sessions—Friday Morning, July 14

Engineering Institute of Canada

PANEL DISCUSSION—EDUCATION FOR MANAGEMENT

9:30 A.M. **BALLROOM**

Moderator: F. C. Mechin, M. EIC, Director, Imperial Oil Ltd., Toronto, Ontario

Panel Members:

DR. LILLIAN GILBRETH, Gilbreth, Inc., Montclair, N.J.

LT. COL. LYNDAL URWICK, Industrial Consultant, London, England.

REAR ADMIRAL CARL H. COTTER, (CEC) USN (Ret.) M. ASCE; President, Merritt, Chapman & Scott Corp., New York, N.Y.

PROF. S. G. HENNESSEY, Department of Political Economy, University of Toronto.

City Planning Division

9:30 A.M. **PARLOR 10**

Presiding: L. V. Sheridan, M. ASCE, Chairman, Executive Committee, City Planning Division

9:30 The Municipal Engineer in Civic Development

C. D. WIGHT, Works Commissioner, Ottawa, Ontario.

10:00 Discussion

10:30 Development of Toronto During Last Half-Century

MURRAY S. STEWART, Works Commissioner, Toronto, Ontario.

Irrigation Division

9:30 A.M. **PARLOR 9**

Presiding: P. M. Sauder, M. EIC, General Manager, Western Irrigation District, Strathmore, Alberta

9:30 Air Photo Interpretation and Application to Soil Investigators

10:00 Irrigation of Glacial Soils

10:30 Water Requirements of Crops

11:00 Flood Control Works, All-American Canal, Coachella Branch

W. R. SLATER, Assoc. M. ASCE; H. G. CURTIS, M. ASCE, and P. A. OLIVER; U.S. Bureau of Reclamation, Denver, Colo.

Joint Membership Luncheon

Friday, July 14, 12:30 p.m.

Presiding: W. I. W. Reid, Vice Presisident, EIC; President, Otis Elevator Co., Ltd.

LT. COL. LYNDAL URWICK, Industrial Consultant, London, England, will deliver an address on

Management Development in Britain

All members of EIC and ASCE, their ladies, guests and friends are cordially invited to attend. Price, $2.50 per plate.

Structural Division

9:30 A.M. **TUDOR ROOM**

Presiding: Raymond Archibald, M. ASCE, Member, Executive Committee, Structural Division, and A. W. F. McQueen, M. EIC, Niagara Falls, Ontario

9:30 Design Procedure Used in Perma-Frost Region

LOUIS A. NEES, Assoc. M. ASCE; Headquarters Air Materiel Command, Wright-Patterson Air Base, Dayton, Ohio.

10:00 Torsion of I-Beams

JOHN E. GOLDBERG, Assoc. M. ASCE; Associate Director, Fundamental Mechanics Research, Illinois Institute of Technology, Chicago, Ill.

10:30 Fabrication and Erection of Arvida Aluminum Bridge

C. J. PIMENOFF, M. EIC; Structural Designer, Dominion Bridge Company Limited, Lachine, Quebec.

11:00 Recent Canadian Developments in Cold Riveting of Aluminum

ERNEST ANDERS, General Engineering Department, Aluminum Laboratories Ltd., Montreal, Quebec; and D. G. ELLIOT, M. EIC, Assoc. M. ASCE; General Engineering Department, Aluminum Laboratories Ltd., Montreal, Quebec.

Technical Division Sessions—Friday Afternoon, July 14

Engineering Institute of Canada—Technical Session

2:30 P.M. **TUDOR ROOM**

Development and Construction of the Inter-Provincial Pipeline

L. F. KAHLE, Executive Vice-President, Inter-Provincial Pipe Line Co., Toronto, Ontario.

Panel Discussion

INDUSTRY AND ENGINEERING EDUCATION

2:30 **BALL ROOM**

Moderator: C. R. Young, Dean Emeritus, Faculty of Applied Science and Engineering, University of Toronto

Panel Members:

R. M. HARDY, Dean of Engineering, University of Alberta.

I. R. TAIT, Chief Engineer, Canadian Industries Limited.

E. O. TURNER, Dean of Engineering, University of New Brunswick.

A. M. REID, Bell Telephone Co. of Canada, Montreal.

K. F. TUPPER, Dean of Applied Science and Engineering, University of Toronto.

Sanitary Engineering Division

Presiding: A. E. Berry, M. EIC, Director, Sanitary Engineering Division, Ontario Department of Health, and Frank W. Jones, M. ASCE, Secretary, Executive Committee, Sanitary Engineering Division

2:00 Toronto Sewage Treatment Plant

2:30 Water Conservation by Pollution Control in the Ohio River Valley

EDWARD J. CLEARY, M. ASCE; Executive Director and Chief Engineer, Ohio River Valley Water Sanitation Commission, Cincinnati, Ohio.

3:00 Boundary Waters Investigation

3:30 Industrial Wastes Disposal—The Plant Survey

FRANK WOODBURY JONES, M. ASCE; Partner, Havens and Emerson, Consulting Engineers, Cleveland and New York.

Highway Division

2:00 P.M. **PARLOR 10**

Presiding: John W. Wheeler, M. ASCE, Chairman, Executive Committee, Highway Division, and W. L. Saunders, M. EIC, Division Engineer, Ontario Department of Highways, Ottawa, Ontario

2:00 Toll Roads

ROY E. JORGENSEN, M. ASCE; Deputy Commissioner, Connecticut Department of Highways.

2:30 Dual-Lane Highways

ALLAN F. FLINTOFF, Division Engineer, Ontario Department of Highways.

3:00 Concrete Pavements

CLIFFORD M. HATHAWAY, M. ASCE; Chief Highway Engineer, Department of Public Works & Buildings, Division of Highways, Springfield, Ill.

3:30 Bituminous or Flexible-Type Pavements

T. F. FRANCIS, M. EIC; Assistant Chief Engineer of Construction, Department of Highways, Ottawa, Ontario.

City Planning Division

Presiding: A. E. K. Bunnell, M. EIC, Consultant, Community Planning Branch and Dept. of Planning and Development, Ontario

2:00 Planning Requirements for the Urban Redevelopment Program of the 1949 Housing Act

CARL FEISS, Chief, Community Planning and Development Branch, Housing and Home Finance Agency, Washington, D.C.

2:30 Local Application of the Redevelopment Program

LOUIS B. WETMORE, Executive Director, Providence Redevelopment Agency, Providence, R.I.

3:00 Discussion led by

ALEX LINN TROUT, M. ASCE; Highland Park, Mich.

MYRON HENDEE, Assoc. M. ASCE; Chief Land Planning Consultant, Federal Housing Administration, New York, N.Y.

Annual Banquet of the Engineering Institute of Canada

Friday, July 14 — **Royal York Hotel** — **Banquet Hall**

6:30 Cocktails
7:30 Banquet
10:00 Reception
10:30 Dancing
Chairman: J. E. ARMSTRONG, President, EIC
Honorary Chairman: ERNEST E. HOWARD, President, ASCE
Speaker: THE HON. LESTER B. PEARSON, Secretary of State for Canada, Ottawa, Ontario
Presentation of Institute Medals and Awards
Induction of President for 1950
JAMES A. VANCE, M. EIC, M. ASCE; Woodstock, Ontario.

Presentation of new Institute Officers

The retiring President, JOHN E. ARMSTRONG and MRS. ARMSTRONG, the incoming President, JAMES A. VANCE and MRS. VANCE, President of the ASCE, ERNEST E. HOWARD and MRS. HOWARD, and the Chairman of the Toronto Branch, E. ROSS GRAYDON and MRS. GRAYDON will receive the members, ladies and their guests.

Dress Optional. $5.00 per plate including dance.

Tables subject to advance reservation.

Tickets will be available at $2.00 per person for those who wish to attend the dance only.

Hotel Accommodations and Meeting Headquarters

Make Hotel Reservations Early

The Hotel Royal York in Toronto is the headquarters of the Joint Convention. Most Convention activities, unless otherwise noted, will be held in this hotel.

All those planning to attend the Convention are urged to make requests for room reservations as early as possible. Late requests, or those who so specify, will be assigned space in nearby hotels.

All requests received after June 20, may have to be assigned to other hotels.

Send all requests for Convention reservations to:

The General Secretary
The Engineering Institute of Canada
2050 Mansfield Street
Montreal 2, Quebec, Canada

Requests should mention your attendance at the Convention. A special request form is printed on page 76 of this issue for your convenience.

Unaccompanied delegates should indicate whether they will be prepared to share twin-bedded double rooms. It is most satisfactory, of course, if such sharing arrangements can be worked out in advance and stated on the application for reservations.

Special reduced convention railway fares have been authorized for rail traffic in Canada. American delegates who can arrange to travel a considerable distance through Canada and who are prepared to buy the tickets for this portion of the trip when they enter Canada, should ask for the railway certificate which entitles the delegate to a round-trip ticket for one and one-half times the one-way fare.

Hotel Rates per day, European plan

	1 PERSON	2 PERSONS	3 PERSONS
ROYAL YORK:			
Double with bath	$ 6.00 up	$ 9.50 up	....
Bed-sitting rooms, special	9.00	12.50	....
Suites	15.00–20.00	19.00–25.00	$26.50–35.50
KING EDWARD			
Double with bath	....	$ 8.50 up	....
Single	$ 5.00 up		
Suites		Various Prices	
BARCLAY:			
Double room, connecting bath	$ 4.50	$ 6.00–8.50	$ 8.00–10.50
Single room (shower)	4.00	....	....
Single room (bath)	4.50	....	....
Suites	....	12.00	14.00
WALKER HOUSE:			
Double with bath	....	$ 6.00	....
Single with bath	$ 3.50	....	....
Double without bath	....	4.50–5.00	....
Single without bath	2.50	....	....

Joint Convention Committee

E. ROSS GRAYDON, *Chairman*

Reception
J. F. Maclaren

Finance
E. A. Cross

Entertainment
W. H. Patterson
W. E. Bonn

Plant Visits
R. S. Segsworth

Ladies
Mrs. E. R. Graydon

Registration
E. G. Tallman

Hotel Arrangements
C. D. Carruthers

Publicity
D. C. Beam

Industry
F. P. Flett
D. D. Whitson

Exhibits
MacK. McMurray

Papers
J. G. Hall

Management
J. F. Harris

Secretary
M. J. Wardle

SOCIETY NEWS

For Proceedings Abstracts and Order Blank, See Pages 99 and 100

ASCE Spring Meeting Attracts 1,548 to Los Angeles

EXCEPTIONAL ORGANIZATION AND attention to details, both technical and social, made the Society's Spring Meeting, to which the Los Angeles Section was host, April 25–29, an outstanding occasion. An unprecedented Spring Meeting registration of 1,548 engineers and their families contributed to the success of the program, which was headed by Ray L. Derby as general chairman of the meeting committees. Mrs. Derby was chairman of the large committee of women who entertained the lady visitors.

Opening Session on Tuesday Night

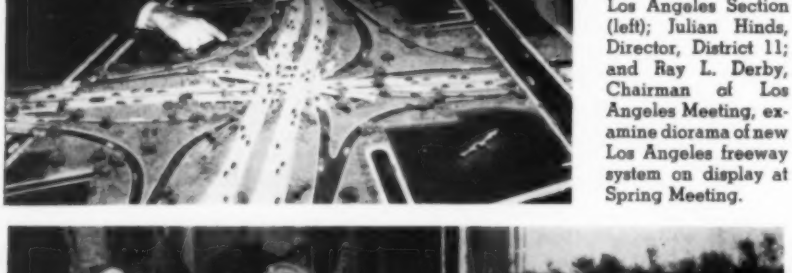
In the leading address at the opening banquet on Tuesday night Clarence A. Dykstra, chancellor of the University of California at Los Angeles, made a strong plea for greater engineer participation in public affairs. "Some of the great talent now to be found in great engineering groups such as this one must be put to public use both in the field of making public opinion and in public operation at a high level," he stated. "There should be more engineers in Congress and in the Senate as well as in executive posts in Washington if the engineering mind is to make its contribution to social America. This is true also at state and local levels."

Stressing the role of the engineer in combating "current tendencies toward the welfare state," Dr. Dykstra defined the welfare state in these terms: "How do we give those who must rely on jobs for a living, the opportunity which the American system was designed to promise? If this is done through private channels, it is our orthodoxy that we have the American Way. If we must rely on government to work this out, we have what is called in this day and age the 'welfare state.' "

All who heard Dr. Dykstra's inspiring talk will be saddened to learn of his sudden death at his summer home at Laguna Beach on May 6.

Another feature of the Tuesday night program, which constitutes a valuable innovation in meeting procedure in allowing early start of the Technical Division sessions on Wednesday morning, was a brief talk by Agustin M. Valdes, president of the newly formed Mexico Section of the Society. Mr. Valdes affirmed the pleasure of Mexican engineers in affiliating with the Society, and received a token for the new Section consisting of crossed flags of Mexico and the United States. B. J. McMorrow, vice-president of the Hawaii Section, brought greetings from another far-off Society group.

ROBERT R. SHOEMAKER, president of Los Angeles Section (left); Julian Hinds, Director, District 11; and Ray L. Derby, Chairman of Los Angeles Meeting, examine diorama of new Los Angeles freeway system on display at Spring Meeting.



COMMITTEE OF LOS ANGELES WOMEN, in charge of arrangements for visiting ladies at Spring Meeting, includes, left to right, Mrs. George E. Brandow (vice-chairman), Mrs. D. L. Narver, Mrs. R. C. Youngquist, Mrs. Franklin Thomas, Mrs. S. B. Morris, Mrs. R. R. Shoemaker, Mrs. Morris S. Jones, Mrs. Finley B. Laverty, Mrs. P. H. McGauhey, Mrs. R. J. Kadow, and Mrs. Ray L. Derby (general chairman).

Local Problems Studied by Technical Divisions

Meetings of twelve of the Society's thirteen Technical Divisions occupied three full days, with all of Friday devoted to discussion of subsidence of the Los Angeles-Long Beach Harbor area, a problem of prime concern to Southern California. Two of the papers presented in the all-day symposium are printed elsewhere in this issue.

Also appearing in this issue is a paper by Honorary Member Lawrence M. Lawson, American Commissioner of the International Boundary and Water Commission, which attracted wide attention for its timely refutation of a recent article in a non-technical periodical declaring that the Imperial Valley is in imminent danger of inundation from the Gulf of California. Other local problems treated in the 90 Technical Division papers included smog and the water-supply situation. Articles based on other Spring Meeting papers were published in the May issue.

Field Trip to Terminal Island

Most popular of the many field trips arranged to give visiting engineers an idea of the tremendous engineering and industrial expansion of the area was an all-day Saturday trip to the U.S. Naval Base at Terminal Island. There several hundred engineers gained first-hand information on

TEN WEST COAST SECTIONS SENT DELEGATES to Conference of Local Sections in Los Angeles during recent Spring Meeting. Seated, left to right, are P. A. Rice, Virginia; Warren D. Curtis, Los Angeles Junior Forum; George S. Salter, conference chairman; Rufus H. Carter, Jr., New Mexico; and John A. Focht, Texas. Center row shows Glenn B. Woodruff, San Francisco; George P. South, Intermountain; Agustin M. Valdes, Mexico; Edwin F. Sullivan, Sacramento; J. Frank Jorgensen, San Diego and Eugene M. Zwoyer, New Mexico. In top row are August L. Ahlf, Colorado; M. T. Wilson, Intermountain; Robert R. Shoemaker, Los Angeles; Robert D. Dewell, San Francisco; and B. J. McMorrow, Hawaii. Several delegates were absent when photo was taken.

subsidence of the Island, which is now at the rate of about a foot and a half a year.

Junior and Student Activities

The interests of younger members and student engineers were served in a large Junior Forum luncheon and panel discussion and in a conference of student delegates from West Coast colleges, which is reported briefly in the write-up of student regional conferences. Several hundred young engineers attending the Junior Forum luncheon heard A M Rawn, chairman of the ASCE Committee on Salaries, review the engineering employment situation in a highly helpful talk.

After outlining the role of the Society in determining fair salaries for classified jobs, Mr. Rawn tried to give an idea of the criteria influencing prospective employers in making a choice between equally well educated young men. Once hired, he warned, there are still high standards, both professional and personal, to be met by the young man hoping ultimately to fill an important senior vacancy.

Effective Local Publicity

Many of the Meeting papers and activities were widely publicized in West Coast papers. Contributing to local interest in the Society and the profession was a series of radio and television broadcasts arranged over municipal hooks-ups by the local Publicity Committee. In these broadcasts the role of the engineer in modern life was explained by panels of Society officers and others. Harry Hayes headed the Publicity Committee.

Military Situation and Unification Explained to Engineers

NEARLY 100 PROMINENT engineers from many parts of the country heard officials of the U.S. Department of Defense discuss the tense world military situation at a meeting in Washington, D.C., on May 11. Unification of the armed forces, the reasons for unification, and progress to date to that end also received attention.

Representatives of the five Engineers Joint Council societies, at their own expense, accepted an invitation from Secretary of Defense Louis Johnson to spend a full day at a Pentagon Building conference for the engineering profession. The Defense Department speakers minced no words, within reasonable security limits, in placing their estimate of the situation before the engineer group. All stressed the vital importance of the engineering profession in helping to maintain peace or in fighting a possible war.

Chairman for the meeting was Lt. Commander Clarence Cisin, U.S. Navy. After remarks by Col. E. B. LeBailly, USAF, chief, National Organizations Branch, The Hon. Paul Griffith, Assistant Secretary of Defense, welcomed the engineers to the Pentagon Building.

Paul H. Nitze, director, Policy Planning Staff, State Department, spoke on "Plans and Problems of Foreign Policy"; Maj. Gen. Lyman Lemnitzer, USA Director, Office of Military Assistance OSD, on "Application of the Military Aid Program"; Felix Larkin, General Council, Department of Defense, on "Unification"; Brig. Gen. Delmar T. Spivey, USAF Chief, War Plans Division Directorate of Plans and Operations, on "Air Defense of the U.S."; Dr. S. D. Cornell, Director, Planning Division, Research & Development Board, on "The Research and Development Program"; and Rear Admiral Frederick E. Haeberle, USN, Assistant Chief, Bureau of Ships, Department of the Navy, on the "Navy's Postwar Shipbuilding and Conversion Program."

At the conclusion of the conference, Alex D. Bailey, a past-president of EJC, expressed the appreciation of the group for the timely information given.

Army Organization Legislation Introduced

A REWRITTEN BILL covering Army Organization (H.R. 8198) was introduced in the House on April 25 by Congressman Paul J. Kilday, of Texas. Readers will recall engineer objections to the Army reorganization legislation introduced in the first session of the 81st Congress last year. (See page 33 of CIVIL ENGINEERING, for October 1949—"Snafu Again.")

Following presentation of the point of view of the engineering profession by a panel of Engineers Joint Council headed by Carlton S. Proctor, M. ASCE, the new bill was written to contain provisions maintaining the professional status of engineers and scientists in the Army. Two of the new provisions are quoted:

"*Sec. 306 (f)* Under regulations prescribed by the Secretary of the Army, officers of the Army assigned to technical, scientific, or other professional duties shall possess qualifications suitable for the performance of these duties; and, when the duties involve the performance of professional work, the same as or similar to that usually performed in civil life by members of a learned profession such as engineering, law, medicine, or theology, they shall, unless the exigencies of the situation prevent, possess, by education, training, or experience, qualifications equal or similar to those usually required of members of that profession."

"*Sec. 404 (e)* Nothing in this Act shall be construed as reducing or eliminating the professional qualifications required by existing laws or regulations of officers of the several different branches of the Army."

In the language of part of *Sec. 306 (f)* engineering is frankly and properly placed among other "learned professions."

Board Actions at Los Angeles Abstracted by Secretary

A RESUMÉ OF actions taken by the Board of Direction at its meeting in Los Angeles, April 24–25, follows:

Constitutional Amendments

As a result of the adoption by the membership of an amended Constitution on April 19, the terms of elected officers were established for a period of transition beginning January 17, 1951, as follows: President, nine months; Vice-President Zones II and III, one year and nine months; Director Districts 1, 4, 14 and 15, two years nine months; one Director from District 11, two years nine months; and one Director from District 11, one year nine months.

New By-Laws Being Drafted

After the July Board meeting, a draft of the new By-Laws will be referred through the Directors, to all Local Sections for study, criticism, and recommendations.

Division Commendations

For the excellence of their reports of the 1949 activities of the Technical Divisions, letters of commendation were sent to the chairmen of the following Divisions: Air Transport, Hydraulics, Power, Sanitary Engineering, Soil Mechanics and Foundations, and Structural Divisions.

Future Meeting Dates

In addition to coming meeting dates shown in a box elsewhere in this issue, the following have been selected: Louisville, Ky., June 13–15, 1951; New York (Annual Meeting), October 22–25, 1951; New Orleans, La., March 5–7, 1952; and Denver, Colo., June 16–20, 1952.

"Proceedings" Separates

The Committee on Publications reported favorable reaction to and general adoption of the PROCEEDINGS Separates plan. It was also reported that, after July 1950, the Technical Divisions will review all technical papers and pre-edit those accepted in accordance with manuals developed by the committee.

Student Chapters Commended

The Board approved the President's Letter of Commendation to 15 Student Chapters and letters of Honorable Mention to 22 others for the excellence of their 1949 programs and reports thereon. The Chapters are listed elsewhere in this issue.

ASCE Conventions

To give encouragement to Local Sections interested in having an ASCE Convention, the Board reaffirmed the sentiments expressed in its February 18, 1948 letter to Local Sections, namely "The scheduling of an ASCE Convention need not be a financial burden on even the smallest of Sections. All functions should be self-supporting and prices of tickets should be fixed to include gratuities and other incidental expenses. Members of the Board would gladly bear their share of the cost of their entertainment."

Society Prizes

The Board announced the award of six Society Prizes, for papers published in Volume 114 (1949) of TRANSACTIONS as follows:

The Norman Medal—Paper No. 2385 "Dynamic Instability of Truss-Stiffened Suspension Bridges Under Wind Action" by Friedrich Bleich, M. ASCE (posthumously).

The J. James R. Croes Medal—Paper No. 2368, "The Significance of Pore Pressure in Hydraulic Structures" by L. F. Harza, M. ASCE.

The Thomas Fitch Rowland Prize—Paper No. 2387, "Mississippi River Bridge at Dubuque, Iowa" by R. N. Bergendoff and Josef Sorkin, Members ASCE.

The James Laurie Prize—Paper No. 2374-C, "Application of Test Results to Quay Wall Design" by Harris Epstein, Esq. (posthumously).

The Collingwood Prize for Juniors—Paper No. 2378-E, "Ship Performance in Restricted Channels" by C. A. Lee and C. E. Bowers, Junior Members ASCE.

The Arthur W. Wellington Prize—Paper No. 2384, "Expansion Joint Practice in Highway Construction" by A. A. Anderson, Assoc. M. ASCE.

Visits

President Ernest E. Howard reported that he has visited 30 groups of ASCE members and students since his inauguration in January.

ASCE BOARD OF DIRECTION assembles for its Los Angeles Meeting. Seated left to right are Albert Haertlein, Vice-President, Zone II; Fred C. Scobey, Vice-President, Zone IV; Franklin Thomas, Past-President; President Ernest E. Howard; Past-President Richard E. Dougherty; Henry J. Sherman, Vice-President, Zone I; and Robert B. Brooks, Vice-President, Zone III. Second row, in same order, are William N. Carey, ASCE Executive Secretary; Sidney T. Harding, Director, District 11; Gordon H. Butler, Director, District 7; Morris Goodkind, Director, District 1; Paul L. Holland, Director, District 6; William Griffin, Director, District 1; Harold L. Blakeslee, Director, District 2; Julian Hinds, Director, District 11; and G. Brooks Earnest, Director, District 9. Back row (in usual order) are Francis S. Friel, Director, District 4; George W. Lamb, Director, District 16; Waldo G. Bowman, Director, District 1; Frank L. Weaver, Director, District 5; Kirby Smith, Director, District 1; Edmund Friedman, Director, District 10; Walter J. Ryan, Director, District 12; Louis R. Howson, Director, District 8; and C. Glenn Cappel, Director, District 15.

Student Chapters Sponsor Nine Regional Spring Conferences

DISCUSSION OF VOCATIONAL and professional problems held the stage at large regional student conferences sponsored by ASCE Chapters in all parts of the country during the past spring. Reports on nine of these conferences—the New England, Upstate New York, Philadelphia-Lehigh Valley, Maryland-District of Columbia, Virginia, Rocky Mountain, Texas, Pacific Northwestern, and California—have been received at Society Headquarters and are summarized here.

New England Conference

Delegates from 13 New England Chapters, meeting at Yale University in New Haven on April 22, had an opportunity to hear leaders in four civil engineering fields describe the occupational outlook. The construction field was outlined by Urban D. Gosselin, vice-president of F. H. McGraw & Co., Hartford, Conn.; the consulting field, by Daniel J. Houlihan, project engineer for Knappen, Tippetts, Abbett Engineering Co., New York; public utilities, by Charles E. Smith, vice-president of the New York, New Haven & Hartford Railroad, New Haven; and sanitary engineering, by Warren J. Scott, director of the Connecticut State Bureau of Sanitary Engineering, Hartford.

First and second prizes in the annual student paper contest—consisting of awards of cash and Junior membership in the Society—went to Charles L. Miller, of Massachusetts Institute of Technology, and Gerald F. Thompson, of the University of Connecticut. The third prize, a Junior membership award, was won by Kenneth T. Risberg, also of the University of Connecticut. There were eleven contestants.

The feature of the evening dinner meeting, held in conjunction with the annual regional conference of New England Local Sections (Connecticut, Northeastern, and Providence), was a talk by William J. Cox, consultant to the Pennsylvania Highway Commission and former Highway Commissioner of Connecticut. Mr. Cox emphasized the importance of the engineer in the solution of problems presented by our developing civilization.

NORMAN H. NOSENCHUCK, of Syracuse University, chairman of Upstate New York Conference (center) is shown with Neal Fitz-Simons of Cornell, winner of second prize (left), and Angelo San Fillipo of Syracuse, first prize winner.

During the program, the Connecticut Section's annual prizes to the outstanding civil engineering seniors at universities in the state were awarded to Edward W. Broadbent, of Yale, and Charles A. Jaworski, of the University of Connecticut.

Conference officers were Conrad Wysocki of Yale, chairman; Melvin Rubin of Tufts, vice-chairman; and Jack Wilbur of M.I.T., secretary-treasurer.

Upstate New York

The Syracuse University Chapter was host to the second postwar conference of Upstate New York Chapters, which was attended by more than 100 students from Union and Clarkson colleges, Rensselaer Polytechnic Institute, and Cornell and Syracuse Universities.

In the morning the group visited the Ley Creek sewage disposal plant, the Onondaga war memorial, and a proposed veterans' hospital. Opening the afternoon program, D. B. Steinman, New York consultant and bridge authority, presented bridge construction problems and their solution. Methods of road construction were discussed by C. E. Swain, division engineer for the Bureau of Public Roads at Albany, and Theodore M. Matson, director of the Bureau of Highway Traffic at Yale University, lectured on traffic problems and proposed highway designs for relief of the situation.

In the annual student paper contest first prize of $50, presented by the host Chapter, went to Angelo San Fillipo, of Syracuse, and second prize of $10 to Neal Fitz Simons, of Cornell.

Philadelphia–Lehigh Valley

Attendance at the twelfth annual conference of Chapters in the Philadelphia and Lehigh Valley Sections, held at the University of Delaware on April 24, broke all previous records with a total of 345.

Much of the all-day program was devoted to the annual student paper contest, in which prizes were presented as follows: William E. Corgill of Bucknell University, first prize consisting of $10 in cash and entrance fee and one year's dues as a Junior Member; Robert Roth of Princeton, second prize of entrance fee and one year's dues as Junior Member; and Edwyn L. Shoemaker, Jr., of the University of Pennsylvania, third prize of a year's dues as Junior Member. Fourth and fifth prize winners—Theodore Davis, of Drexel Institute, and Robert Sollazzo, of Villanova College—received one-year subscriptions to CIVIL ENGINEERING.

Following a group luncheon at noon, the group inspected the Delaware River Memorial Bridge at Wilmington.

Maryland–District of Columbia

The ninth annual meeting of Chapters in the Maryland and District of Columbia Sections was held at the Catholic University of America in Washington on April 22, with delegates present from George Washington University, Johns Hopkins University, and the University of Maryland. An address on "Moving a Monastery in Quebec on 300,000 Balls," by Robert E. White, of the firm of Spencer, White & Prentis, underpinning and foundation specialists, featured the morning program. Afternoon inspection tours took in the District of Columbia Courthouse and other projects in the area.

MORE THAN 150 REPRESENTATIVES of 13 engineering schools in New England are photographed at all-day conference in New Haven, to which Yale University and New England Conference of Local Sections were hosts on April 22.

SCENE AT DINNER MEETING concluding Maryland-District of Columbia Conference shows Albert Fiedler, president of District of Columbia Section, addressing joint group. At his right are Arthur Montgomery, head of Placement Center, Catholic University; H. R. Hicks, Bureau of Reclamation; Cadet French, representing Col. R. A. Marr, Jr., of Virginia Military Institute; Andrew Gabrysh, president of host Chapter; and (partly visible) Robert Kadala, Junior Contact Member. At speaker's left are Father J. J. O'Sullivan, university chaplain; A. J. Scullen, dean of engineering and architecture at Catholic University; and (partly visible) Wesley Nelson, Assistant Commissioner of Reclamation.

At the dinner meeting that concluded the program Kenneth W. Markwell, Assistant Commissioner of Reclamation, was principal guest speaker. Advantages of affiliation with the Society were discussed by Albert Fiedler, president of the District of Columbia Section, who brought greetings from the Section to the group.

Virginia Conference

The engineer as a builder is in a strategic position to impress the people of the world with the superior quality and performance of the American ideology, John F. Gange, director of the Woodrow Wilson School of Foreign Affairs, said in a leading talk at the Virginia Conference, to which the University of Virginia was host in Charlottesville on April 28. Speaking on "Engineers and Foreign Affairs" before 100 delegates from Virginia Military Institute, Virginia Polytechnic Institute and the host Chapter, Dr. Gange urged increased interest in both foreign and civic affairs. "The engineer is in demand for the conduct of our foreign relations in rapidly increasing urgency and proportion, as compared with other professions and other times," Dr. Gange told the group.

In a talk on "Highway Engineering as a Career," C. S. Mullen, chief engineer of the Virginia Highway Department, outlined the department's unique training program designed to attract able graduates to the field. R. E. Pillow, of Virginia Polytechnic Institute, was awarded first prize in the annual student competition with a talk on "Civic Engineering." Mr. Pillow said that greater public understanding of engineering principles and aims will be required before engineers have the necessary influence to perform fully effective public service.

Delegates to the all-day session had the choice of an afternoon tour of the engineering school laboratories or of the $3,000,000 dormitory construction project and the enlarged filtration plant of the City of Charlottesville.

Rocky Mountain

ASCE President Ernest E. Howard and Director George W. Lamb attended the Rocky Mountain Conference, which was held in Denver in April in conjunction with the first Regional Conference of Local Sections in the Intermountain Area, reported elsewhere in this issue. The attendance of 350 included student delegations from the University of Wyoming, South Dakota School of Mines and Technology, the University of Colorado, and Colorado A. & M. College.

Junior membership in the Society was awarded to Eugene Miller, of Colorado A. & M. College, for the winning student paper, which was on prestressed concrete. Illustrating the principles of prestressing with diagrams, Mr. Miller traced the origins of the technique in Europe and predicted its increased use in this country. Second prize of a year's subscription to CIVIL ENGINEERING was given to Paul C. Ness, of the South Dakota School of Mines and Technology, for a report of experiments on the shrinkage of cement and cinder blocks. A set of ASCE Manuals went to Robert A. Davis, of the University of Colorado, who placed third.

The student representatives heard Mr. Howard speak at a luncheon meeting during the two-day program and took part in inspection trips arranged by the Bureau of Reclamation.

Pacific Northwestern Conference

A panel discussion featuring "Suggestions to the Engineering Graduate Starting a Career" was a highlight of the third annual Pacific Northwestern Conference Montana State College Chapter was host in Bozeman. Career suggestions were presented by T. Haggerty, of the Haggerty-Messmer Co., Bozeman; H. Nicholson, Corps of Engineers, Fort Peck; W. Wenzel, consulting engineer of Great Falls; and J. Morrison, of Morrison-Maierle, Inc., Helena.

First prize in the student paper contest went to Don Parks, of the host Chapter, and second prize to Joe Van Vliet, of Washington State College. A special Montana Section award of Junior membership in the Society was given to Al Craft, of Montana State, for outstanding college work.

Preceding the all-day meeting at Bozeman, the student group made a two-day tour of Montana projects that included Hungry Horse Dam, the Butte copper mines, and the Canyon Ferry Project. A buffet picnic supper at Reclamation Camp and attendance at a meeting of the Montana Section concluded the inspection tours.

Texas

Six engineering schools in Texas were represented at the Texas Conference of Student Chapters, held at Dallas, May 1 to 3, in conjunction with the annual spring meeting of the Texas Section. The total attendance of 585 included 283 students.

Highlight of the meeting for the student group was the traditional breakfast, to which the Chapter was host on May 3. First prize in the annual student paper contest, in which there were six entries. was awarded to Gordon Landwermeyer, of Texas Tech, for a paper on air-entraining concrete. C. A. Miller, of Texas A. & M. College, received second prize for a paper on "The Young Civil Engineer and the Code of Ethics."

Transportation was the theme of the meeting, with various phases of the subject discussed by the following speakers: T. S. Reece, vice-president and general manager of the Continental Trailways Bus System; W. G. Vollmer, president of the Texas & Pacific Railway Co.; H. B. Dyer, president of the Nashville Bridge Co.; and Boone T. Guyton, chief pilot and military liaison of the Chance Vought Aircraft Corp. An inspection tour of the Chance Vought plant for the entire Section and student group supplemented Mr. Guyton's talk.

ASCE Vice-President Fred C. Scobey was principal speaker at the annual men's

PARTICIPANTS IN TEXAS CONFERENCE student paper contest, culled from preliminary competitions in Texas schools, are (left to right): Dan Zabcik, University of Texas; G. W. Hansen, Rice Institute; Gordon Landwermeyer, Texas Tech (first prize winner) Bob Miller, Southern Methodist University; Carlos Blanco, Texas Western; and C. A. Miller, Texas A. & M. (second prize winner).

luncheon. During the program life membership certificates were awarded to the following members of the Texas Section: G. G. Edwards, C. S. Henning, Jr., A. P. Rollins, P. A. Welty, John H. Bringhurst, and John A. Elliott.

California Conference

More than 350 students from Western universities as remote from Los Angeles as the University of Alaska and the University of New Mexico attended the third California Conference of Student Chapters, which was a feature of the ASCE Spring Meeting program in Los Angeles.

Among the program highlights were a vocational conference; a talk on "Accomplishments and Opportunities of the Engineering Profession" by President Howard; and inspection tours of numerous California projects. Winners in the annual student paper contest were Farrell Miles, of Utah State Agricultural College, representing the Intermountain Section (first prize); Anton Arnosti, of Stanford University, representing the San Francisco Section (second prize); and Cedric A. White, of the University of Southern California, representing the Los Angeles Section. The other six contestants received book prizes.

FROM THE NATION'S *Capital*

JOSEPH H. EHLERS, M. ASCE
Field Representative ASCE

NORMAL PROGRESS WAS made during the month in the legislative matters in which the Society has expressed interest. The National Science Foundation legislation reported last month has been enacted into law. It is to be known as the "National Science Foundation Act of 1950." Public Law 507—81st Congress.

No changes in the basic objectives were made in the conference to reconcile the House and Senate versions. Among other things, the Foundation is authorized to initiate and support basic scientific research in the mathematical, physical, medical, biological, engineering and other sciences by making contracts, including financial assistance, for the conduct of such research; to award scholarships in science and engineering; to foster the interchange of scientific information among scientists in the United States and foreign countries; to evaluate scientific research programs undertaken by agencies of the federal government; and to maintain a register of scientific and technical personnel.

There is an authorization, but as yet no appropriation, for $500,000 for the current fiscal year and $15,000,000 annually thereafter.

The Board will consist of 24 members and will be under the staff direction of a director appointed for a six-year term with a $15,000 salary.

Point IV Legislation in Conference

The Point IV Program of technical assistance to backward areas is making progress toward final enactment. House and Senate conferees have agreed on a $35,000,000 program. This legislation is a part of an over-all bill for world relief and recovery which includes $2,850,000,000 for the European recovery; $100,000,000 for economic recovery in Korea; $94,000,000 for Formosa and the general area of China. The new bill includes the provisions of the House bill for the protection of American private investment.

Advance Planning Funds Allotted

The Advance Planning Program now being carried on by the General Services Agency is making some progress. About 1,300 applications, totaling over $26,000,000 had been received up to the middle of May. Advances for plan preparation have been approved to a total of slightly under $7,225,000. Sewerage facilities and educational building each account for over $2,500,000, with the remaining funds divided between airports, roads, sanitary facilities and miscellaneous buildings. Allotments are currently being made at the rate of $2,000,000 a month. While small projects are the most numerous in this program, there are many of engineering significance. Among these may be mentioned an advance for planning port facilities at Mobile, Ala., with a project cost of $2,000,000; port facilities at Boston to cost over $1,000,000; airport facilities at Columbus costing about $4,000,000 and sewage installations to cost over $1,000,000 each in a dozen or more locations, predominantly in the South and Middle West.

As previously reported, the Bureau handling this work is scheduled, under Reorganization Plan No. 17, to be transferred to the Housing and Home Finance Agency on May 24, unless adverse action is taken by either House of Congress. (See CIVIL ENGINEERING April 1950, Page 58). A resolution was introduced by Senator Aiken opposing the transfer. Considerable sentiment has developed against Plan 17, although it is perhaps doubtful if the matter is of sufficient interest to muster the necessary 49 votes against it. Many competent observers express the view that the plan to transfer the agency appears to have been carelessly developed, is generally contrary to the Hoover recommendations, and brings confusion by adding such extraneous matters as planning port developments, airports, natural gas systems, sewage disposal plants and public buildings to the already complex picture of developing a housing program and clearing slums with which the Housing Agency has been struggling.

House Votes Public Roads Funds

The house passed and sent to the Senate a bill authorizing $1,273,000,000 in federal aid for public roads during 1952 and 1953. For general aid to the states for roads, the bill authorizes $500,000,000 for each of the two years to be matched equally with state money. Also included in the measure for the first time is a special fund of $70,000,000 anually for the interstate highway system to be matched by 25 percent of state money. This special fund will be used under federal plans to perfect the defense road net of the nation.

Washington, D.C.
May 22, 1950

Student Chapters Receive Board Commendation

FOR OUTSTANDING ACHIEVEMENT during the 1949 school year, a number of ASCE Student Chapters were cited for special commendation at the Los Angeles Meeting of the Board of Direction in April.

The Board's action has been relayed to the 37 Chapters selected in the form of engrossed Certificates of Commendation and President's Letters of Honorable Mention. The Chapters receiving the Certificates and their geographical distribution are:

Northeastern Region
- Cooper Union
- Worcester Polytechnic Institute
- Northeastern University

Middle Atlantic Region
- Carnegie Institute of Technology
- Bucknell University
- Case Institute of Technology

Western Region
- California Institute of Technology
- University of Colorado
- Texas Technological College

Southern Region
- Alabama University
- Florida University
- Virginia Military Institute

North Central Region
- Missouri School of Mines
- South Dakota State College
- Washington University

The President's Letters of Honorable Mention go to these Chapters:

Northeastern Region
- New York University
- Tufts College
- Clarkson College of Technology

Middle Atlantic Region
- Johns Hopkins University
- West Virginia University
- Newark College of Engineering
- Swarthmore College
- Lafayette College
- University of Dayton

Western Region
- University of Arizona
- University of California
- Stanford University
- University of Santa Clara
- Oregon State College
- University of Southern California

Southern Region
- Georgia School of Technology
- Virginia Polytechnic Institute
- University of Virginia
- Alabama Polytechnic Institute

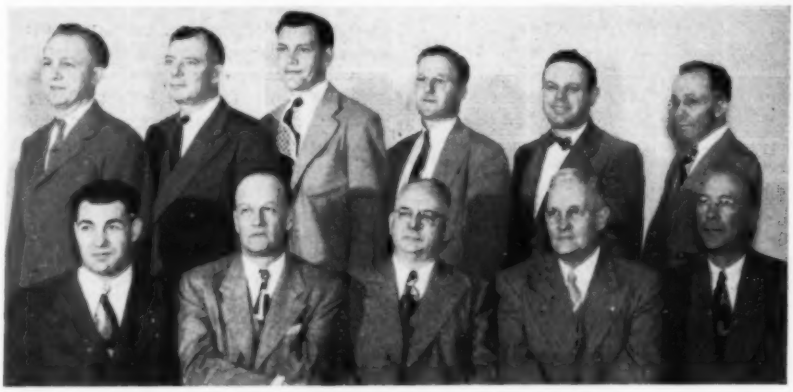
North Central Region
- Illinois Institute of Technology
- Kansas State College
- Rose Polytechnic Institute

Denver Section Is Host to Regional Conference

UNDER SPONSORSHIP OF the Colorado Section, the first regional conference of Local Sections called in the Intermountain Area took place recently in the Denver Federal Center where the facilities of the Bureau of Reclamation's engineering offices were thrown open to about 350 practicing engineers and student delegates. A 3-ft concrete cylinder was broken in the new 5,000,000-lb Baldwin Universal testing machine as a feature of a conference tour of the Bureau's laboratories. Other exhibits included working models of hydraulic structures on Reclamation projects and scientific equipment ranging from earth-testing to petrographic items.

Discussion of Society and Section affairs was headed by ASCE President Ernest E. Howard and Director George W. Lamb at a joint luncheon meeting and round table. Alfred J. Ryan, Denver consultant, spoke on off-street parking problems in a technical session before the luncheon, and Harold Birkeland, assistant chief designing engineer of the International Engineering Co. of Denver, described engineering opportunities in India.

Student participation in the two-day conference is described in the write-up of student regional conferences. Dale S. McMillen was general chairman of the conference.



SOME OF GROUP OF SOCIETY AND SECTION OFFICERS responsible for success of first Local Section Regional Conference in Intermountain Area is shown here. In front row, left to right, are A. L. Ahlf, secretary, Colorado Section; George W. Lamb, Director, District 16; President Howard; and John S. Marshall and W. H. Thoman, Section president and vice-president. In same order, back row, are K. L. Fienup, assistant to secretary, Colorado Section; Earl D. Dake, Faculty Adviser, South Dakota School of Mines & Technology; George Koonsman, Faculty Adviser, Colorado A. & M.; N. D. Morgan, Faculty Adviser, Wyoming University; Leo C. Novak, Faculty Adviser, Colorado University; and Carl A. Gould, member, Executive Committee, Colorado Section.

Members Urged to Report Non-Receipt of Ballots

ON MAY 1 nominating ballots were mailed to all members of Districts and Zones, where Directors and Vice-Presidents are to be elected this year. Following the procedure in the recently amended Constitution, these ballots will be received at Society Headquarters not later than June 29 for counting on June 30. Information on the result of the balloting, together with the final ballot, will go out on or before July 15. The final ballot for election of nominees selected will be closed September 9 and counted on September 10.

All members in good standing, including Affiliates and Junior Members, are entitled to vote. Members in Zones II and III are nominating Vice-Presidents to represent them. Districts 1, 4, 11 (including old District 13 and Hawaii), 14, and 15 are nominating Directors. Blank ballots will be mailed on request to Society Headquarters to any member who has misplaced or has not received the ballot mailed to him.

With this schedule as a guide, members can report immediately unreasonable delays in receiving their ballots. In doing so, they will be rendering the Society a service, and will enable Headquarters to continue to make formal complaints of delay to postal authorities.

Proceedings Separates to Be Issued as Transactions

LIKE THE OLD PROCEEDINGS that they supersede, the new Separates (see pages 99 and 100) will, with their subsequent discussions, also as Separates, eventuate into the next available yearly TRANSACTIONS.

Welding Cuts Structural Costs 12% Saves 7% on Steel

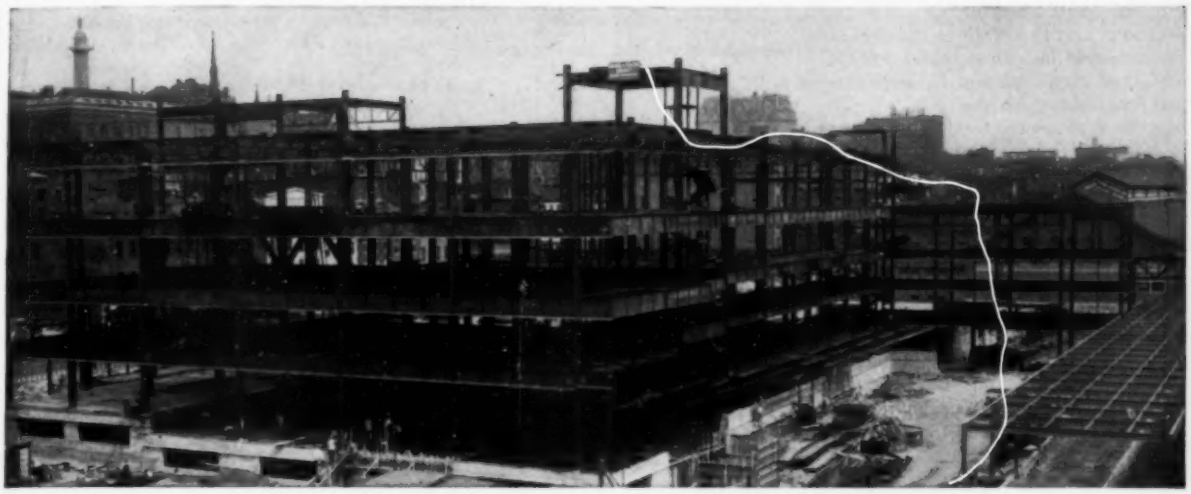


Fig. 1. Framework partially complete for the 5 story plant of Baltimore Sun, Baltimore, Md.
Architects: Palmer, Fisher, Williams and Nes;
Consulting Engineer: Van Rensselaer P. Saxe; General Contractor: George A. Fuller Co.

By VAN RENSSELAER P. SAXE
Consulting Engineer
Baltimore, Md.

A SAVING of $68,522 has resulted from the adoption of welded design for the publishing plant of the Baltimore Sun and Evening Sun shown in Fig. 1. Structural weight was cut by over 7%. A sizable amount of money was saved also on concrete and form work, as well as on reduced building height made possible by continuous beam design involving shallower structural members.

Typical framework connections illustrating the simple details for field erection are shown in Figures 2—3. Beams are positioned on erection seats or clips and then field-welded with Lincoln® "Fleetweld 5" electrodes using 400 ampere Lincoln "Shield-Arc" motor driven arc welders. In the design of frame members, bevel cuts for connections were so planned as to make maximum use of fast, easy downhand welding.

The quotation of the low bidder for riveted construction was $551,508. The actual cost of the welded frame was $482,986. This accounted for the $68,522 saving in the structure.

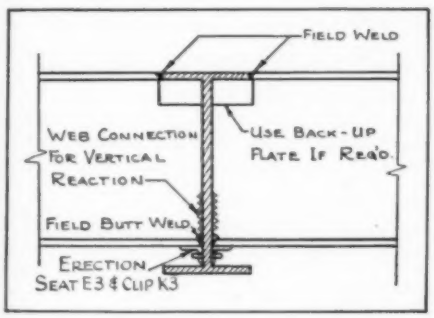


Fig. 2. *Typical beam to girder connection.*

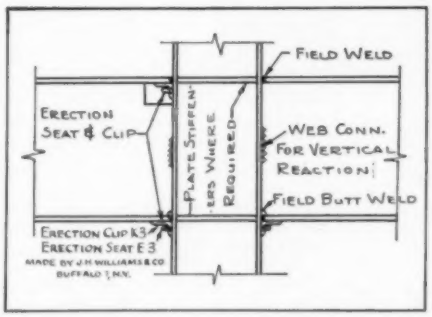

FIELD WELD
ERECTION SEAT & CLIP
PLATE STIFFENERS WHERE REQUIRED
WEB CONN. FOR VERTICAL REACTION
FIELD BUTT WELD
ERECTION CLIP K3
ERECTION SEAT E3
MADE BY J.H. WILLIAMS & CO BUFFALO 1, N.Y.

Fig. 3. *Typical beam to column connection.*

GET THE FACTS

Write for Studies in Structural Arc Welding
THE LINCOLN ELECTRIC COMPANY
Dept. 142, Cleveland 1, Ohio

Sales Offices and Field Service Shops in All Principal Cities

LINCOLN

ASCE Committee Findings on Soil Sampling Issued

RESULTS OF TWELVE years of work by Dr. M. Juul Hvorslev, Assoc. M. ASCE, on a research project of the Committee on Sampling and Testing of the ASCE Soil Mechanics and Foundations Division are now available in a final report, entitled *Subsurface Exploration and Sampling of Soils for Civil Engineering Purposes*. The project was sponsored by the Engineering Foundation, Harvard University, and the U.S. Waterways Experiment Station, which prepared and printed the report.

Distribution of the 520-page report, which constitutes an authoritative reference work on the development and current status of subsurface exploration in general and on sampling of soils and rocks in particular, will be through the Engineering Foundation, 29 West 39th Street, New York 18, N.Y. The price, including shipping charges within the United States, is $4 for members of the four Founder Societies and libraries, and $6 for all others.

Coming Local Section Events

Colorado—Dinner meeting in the Auditorium Hotel, Denver, June 12, at 6:30 p.m.; technical meeting at 8 p.m.

Los Angeles—Seminar on specifications will be held at the California Institute of Technology, June 14. Section field day at Oakmont Club, Glendale, June 27. Tour of Metropolitan Water District water softening plant at La Verne and dinner meeting of Sanitary Group at Rainbow Angling Club, Azusa, June 28, at 6 p.m.

Philadelphia—Meeting in the Engineers' Club, Philadelphia, June 13, at 7:30 p.m.; preceded by dinner at 6 p.m.

Sacramento—Regular luncheon meetings every Tuesday at the Elks Club, Sacramento, at 12:30 p.m.

San Francisco—Weekly luncheons every Wednesday at the Engineers Club of San Francisco.

Scheduled ASCE Meetings

ANNUAL CONVENTION
Toronto, Canada, July 12–14
(See Program, pages 46–49)

FALL MEETING
Chicago, Ill., October 11–13
(Board of Direction meets October 9–10)

SPRING CONVENTION
Houston, Tex., February 21–23
(Board of Direction meets February 19–20)

News of Local Sections Briefed

SECTION	DATE	ATTENDANCE	PROGRAM
Akron	Apr. 14	40	Inspection trip to plant of Macomber, Inc., Canton, Ohio, under guidance of Stanley Macomber, president of firm. E. A. McCusky, vice-president, and general counsel F. W. Stafford talked on engineering designs.
Buffalo	Apr. 18	...	Luncheon meeting featuring B. D. Keatts, regional vice-president of Intrusion Prepakt Co., Inc., as principal speaker.
Central Illinois	Apr. 12	37	Business meeting conducted by Junior Branch. Milo P. Flickinger, executive secretary, Associated General Contractors, gave a talk on highway problems in Illinois.
Colorado	Apr. 10	53	George D. Clyde, chief, Regional Division, Soil Conservation Service, presented a speech entitled, "Research in Irrigation Agriculture."
District of Columbia	Apr. 11	120	Dinner meeting with symposium on "Plans and Planning for the Future of the Washington Region." Participants included John Nolen, Jr., director of planning, National Capital Park & Planning Commission; Clifton G. Stoneburner, highway engineer of Arlington County, Virginia; and Fred W. Tuemmler, director of planning, Maryland-National Capital Park & Planning Commission.
Kansas	Apr. 14	60	Dinner meeting featuring John Ise, professor of economics, University of Kansas, as guest speaker.
Kansas City	Apr. 11	...	Junior Activities Committee meeting. R. O. Drange, of Howard, Needles, Tammen & Bergendoff, discussed the development of expressways and turnpikes and their economic feasibility.
	Apr. 18	80	Dinner meeting. Gail Hathaway presented an illustrated speech on underground power plants and bomb damage to dams in Europe.
Los Angeles	Apr. 12	141	P. O. Harding, district highway engineer, California Division of Highways, described some problems in the freeway program and Loren E. Blakely, consulting engineer, discussed recharging depleted aquifers using Colorado River water.
	Apr. 12	51	Junior Forum meeting with P. G. Hart, executive director of Los Angeles Housing Agency, talking on "Community Redevelopment for Los Angeles."
Maryland	Apr. 12	154	Dinner meeting featuring Ambrose J. Chlada, Bernard F. Kallas, and William N. Duguette, as speakers.
Miami	Apr. 6	27	Dinner and business meeting with several University of Miami students, as guests.
Mid-South Vicksburg Branch	Apr. 10	...	Meeting with C. H. Willets, of Concrete Research Division, Clinton Sub-Office, USWES, speaking on series of tests made on vacuum processing of concrete.
Northeastern	Apr. 17	36	Annual spring dinner meeting with Boston Society of Civil Engineers.
Northwestern	Apr. 3	91	Joint meeting with Minnesota section of Society of American Military Engineers. Gen. S. Sturgis, division engineer, Corps of Engineers, Omaha, Nebr., spoke on "Progress in Design and Construction of Missouri River Dams."
Philadelphia	May 9	...	Joint dinner meeting with Juniors.
Delaware Sub-Section	April	35	Inspection trip to Delaware River Memorial Bridge with Homer R. Seely, project engineer for the consulting firm of Howard, Needles, Tammen & Bergendoff, as host.
Pittsburgh	Apr. 17	31	Juniors' dinner meeting. "The Weather and You" was discussed by Henry Rockwood, regional hydrologic engineer, U.S. Weather Bureau, Pittsburgh, Pa.
Tacoma	Apr. 11	52	Dinner meeting with W. A. Bugge, director of Washington State Department of Highways, speaking. Frank E. Culp, bridge designing engineer, State Department of Highways, showed a colored film of earthquake damage in Olympia.
Venezuela	Apr. 18	...	Technical meeting. Frank S. Gilmore, with the Asphalt Institute, gave an illustrated talk on uses of asphalt, particularly on highways and airports.

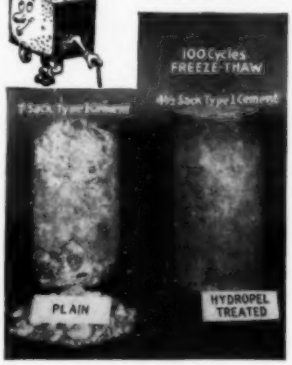
HYDROPEL®

Another Product Pioneered By **Bitumuls**

The Integral Waterproofing Admix for Concrete That "Tops" Them All.

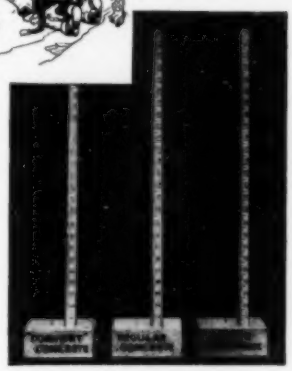
Portland Cement Concrete—accepted world-wide—receives its greatest modern improvement when HYDROPEL is added. We invite your appraisal.

Resists FREEZE-THAW
(Expansion & Contraction)



In combating freeze-thaw action, 4½-sack Hydropel Concrete outperforms 7-sack plain concrete. New England cities specify Hydropel Concrete in curbs and sidewalks where de-icing salts are used.

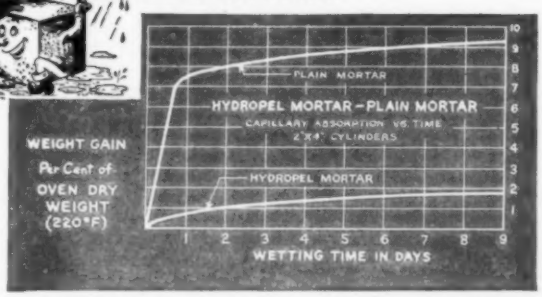
WARM & RESILIENT
(Comfort Concrete)



The rebound of steel balls shows how Hydropel "Comfort" Concrete absorbs impact. Humans and animals like its resilience and dry warmth.

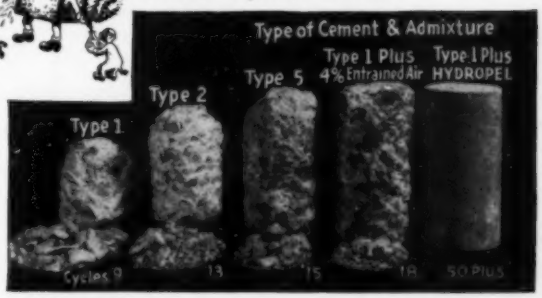
(Photo — courtesy John B. Pierce Foundation.)

IMPERMEABILITY
(Water Resistance)



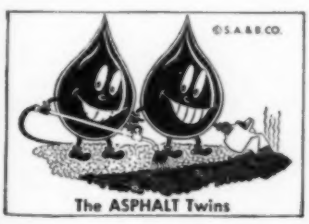
Note that Hydropel Concrete shows a water absorption of only 15% compared with untreated concrete. Absorption with Hydropel is less than ⅓ that of any other "waterproofing" additive. Hydropel Concrete is now used for hydraulic structures.

Resists CHEMICALS
(Solids—Liquids—Gases)



Hydropel Concrete gives superb protection against alkali salts. Over 50 cycles in the salt soundness test do NOT damage Hydropel cylinders—all others fail in relatively few cycles. Chemical plants prefer Hydropel Concrete.

HYDROPEL, perfected in over ten years of engineering research, offers you many exclusive advantages. Try it on a "tough" job NOW.



The ASPHALT Twins

In the West

STANCAL ASPHALT & BITUMULS COMPANY
200 BUSH STREET · SAN FRANCISCO 4, CALIF.
Los Angeles 14, Calif. · Oakland 1, Calif. · Portland 7, Ore. · Tucson, Ariz.

In the East

AMERICAN BITUMULS COMPANY
200 BUSH STREET · SAN FRANCISCO 4, CALIF.
Washington 6, D. C. · Baltimore 3, Md. · Perth Amboy, N. J.
Columbus 15, O. · St. Louis 17, Mo. · Baton Rouge 2, La.
E. Providence 14, R. I. · San Juan 23, P. R. · Mobile, Ala.

Ask for our BITUMULS BOOKLETS. They are factual, illustrated, and helpful—a valuable addition to your engineering library.

- **Bitumuls Penetration Macadam** . . ☐
- **Bitumuls for Maintenance** . . . . ☐
- **Bitumuls Sand-Mix** . . . . . ☐
- **Bitumuls Handbook** . . . . . ☐
- **Hydropel**—Admix for concrete . . . ☐
- **Tennis Courts**—Laykold & Grasstex . ☐
- **Fibrecoat**—roof and metal coating . ☐

NEWS BRIEFS

Record-Breaking Construction Activity Reported in April

CONSTRUCTION ACTIVITY DURING April, led by private homebuilding, exceeded all previous records for the month, according to a recent joint release of the Construction Division of the Department of Commerce and the Department of Labor's Bureau of Labor Statistics. The total value of new construction put in place during the month, estimated at $1.7 billion, represents a seasonal increase of 10 percent over expenditures in March, and of 24 percent above the total for April 1949. During the first four months of the year, a total of 6.1 billion was spent for new construction—20 percent more than in the same period last year.

Total expenditures for all types of new private construction during April, valued at $1,254 million, advanced 9 percent over the previous month and 27 percent above the April 1949 outlay. In the same month public expenditures for new construction came to $443 million—an increase of 15 percent above the March total and 16 percent above the public outlay in April 1949.

Work totaling $720 million was accomplished in April on the record number of new homes that have been started in the past few months. With a seasonal rise of 11 percent over the level for March, the value of new private residential construction for the month was 62 percent above a year ago. For the first four months of the year, new residential construction was 50 percent greater than in 1949.

Private non-residential building did not share in the spring construction advance, with expenditures for factories, store and office buildings, and warehouses at about the same rate in April as in March and somewhat below last year's record for the same period. Outlays for industrial building in April were 21 percent lower than last year, and for the first four months of the year they amounted to 30 percent less than for the same period in 1949. However, expenditures for private hospital construction were still more than double those of a year ago.

There was a seasonal rise in public expenditures for new schools, hospitals, and other types of non-residential construction in April. Highway construction outlays, up about 38 percent during the month, represented a rise of 10 percent over a year ago.

New Mexico Starts Flood Control, Irrigation Works

RECENT GROUND-BREAKING CEREMONIES for the first $3,500,000 section of the $70,000,000 Middle Rio Grande flood-control project ends a 24-year state campaign for flood control and irrigation works in the Middle Rio Grande area. The ground-breaking followed first authorization of the entire $70,000,000 project by a Senate-House conference committee.

Designed to minimize flood danger to a valley area comprising 250,000 persons and $400,000,000 worth of property, the project involves principally a 225-mile control channel running from Espanola to Hot Springs and two major dams, near the confluences of the Rio Chama and Jemez Creek with the Rio Grande.

Continued High Rate of Steel Production Noted

COMPLETION OF THE fourth consecutive week of steel production at 100 percent of theoretical capacity or better is announced by the American Iron and Steel Institute. With steel-making furnaces operating at 100.1 percent of capacity for the week beginning May 8, production of 1,908,200 tons of ingots and steel for castings was scheduled. The week's rate represents an increase over production at the rate of 97.8 percent of capacity a month ago, equivalent to 1,864,300 tons. The present rate of output also exceeds production during the same week last year, which was at the rate of 96.2 percent of capacity and totaled 1,773,500 tons.

The Institute's announcement is based on reports from companies having 94 percent of the steel capacity of the industry.

Program Announced for World Power Conference

SEVERAL ASCE MEMBERS will be represented on the program for the Fourth World Power Conference, to be held in London, July 10–15. Authors in the division on Production of Power include E. Robert de Luccia, chief of the Bureau of Power, Federal Power Commission, and Director Frank L. Weaver, chief of the Bureau of Water Power, FPC, who have prepared a paper on the current status of hydroelectric power development in the United States; Honorary Member William P. Creager, Buffalo consultant, and William F. Uhl and Byron O. McCoy, president and engineer, Charles T. Main, Inc., Boston, whose paper is entitled "Hydroelectric Power—Available Power and Delivery of Power to the Power House"; and Philip Sporn, president of the American Gas & Electric Service Corp., New York City, who will discuss heat-pump progress in the United States.

Other divisions for which the United States National Committee has submitted papers are Energy Resources and Power Developments and the Preparation of Fuels. Post-conference tours to hydroelectric and other power projects are scheduled for the week following the conclusion of the technical program.

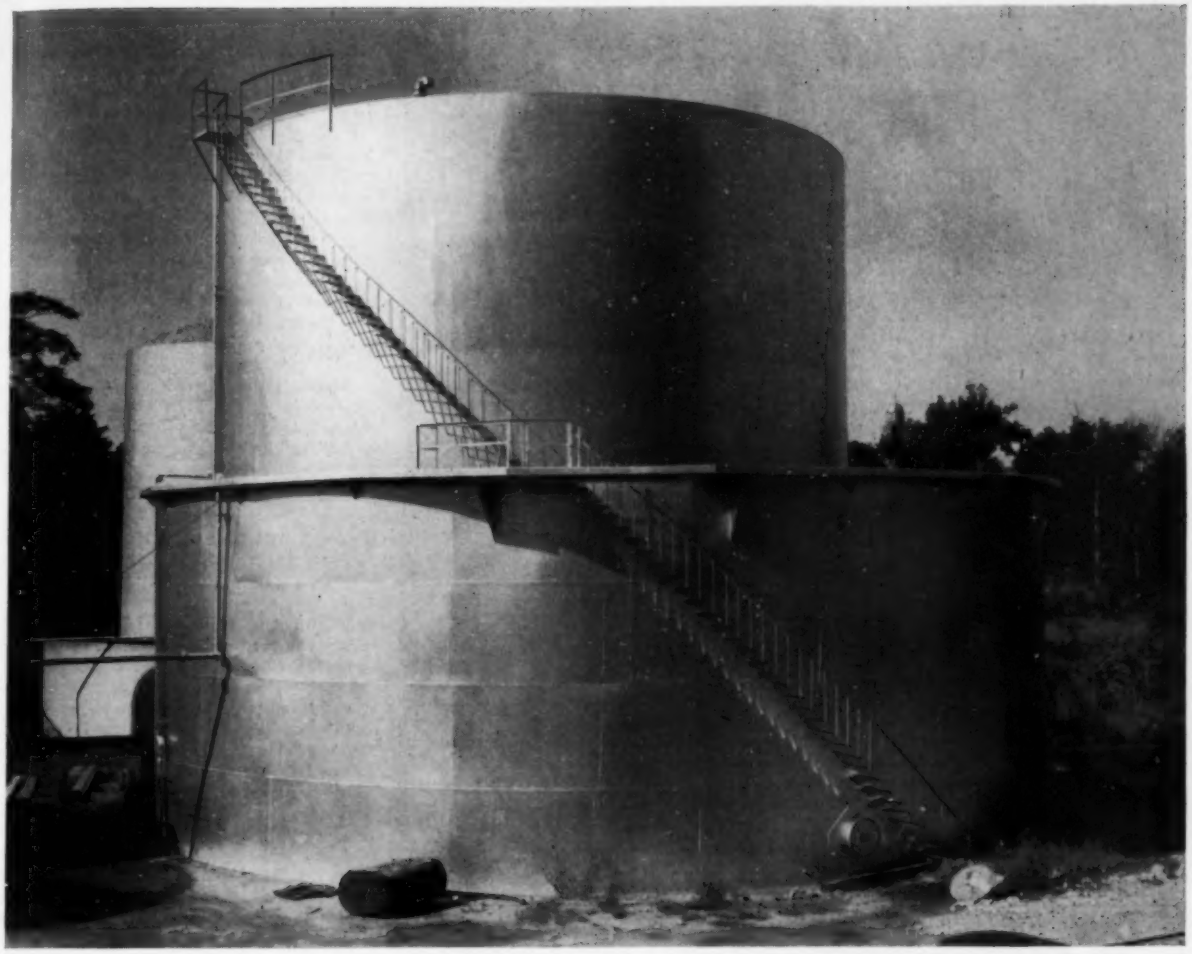
Inquiries should be addressed to H. C. Forbes, secretary and treasurer of the conference, 4 Irving Place, New York 3, N.Y., or the Office of the Fourth World Power Conference, 414 Cecil Chambers, 76/86 Strand, London, W.C. 2, England.

Rise in Urban Building Construction Reported

CITY BUILDING CONSTRUCTION, led by a large volume of residential building, was greater in 1949 than in any year since the mid-twenties, according to preliminary estimates of the Bureau of Labor Statistics of the Department of Labor. Basing its estimates on building permits issued and federal contracts awarded, the Bureau puts a value of $7.4 billion upon urban construction for the year, an increase of 6 percent over 1948 valuations, but somewhat less than the dollar value of construction in 1925 and 1926.

All sections of the country, except the New England and Pacific Coast states, shared in the 1949 increase in the dollar volume of urban building. Most of the decline from 1948 in the New England region was in industrial and commercial building, and in the Pacific Coast area the greatest decrease was in residential construction. The East North Central and Middle Atlantic regions, with $1.5 billion apiece, led all other geographic divisions in the amount of urban building authorized. The Pacific Coast states were third, with $1.2 billion.

Despite a marked drop from 1948 in residential construction, California outstripped the rest of the country in total urban permit valuations in 1949 with New York and Texas ranking second and third, respectively. California has consistently ranked first since 1942—the earliest year for which state data are available. Top-ranking cities in 1949 were New York, Los Angeles, Detroit, Chicago, and Washington, D. C.



EIGHTH Horton* Tank for Stamford Bulk Plant

The 630,000-gallon tank shown in the above view is the *eighth* welded steel oil storage tank that we have supplied for the Stamford, Connecticut, bulk plant of the Independent Oil Company of Connecticut. The other seven are two overhead tanks mounted on high concrete supports and five flat-bottom tanks.

This eighth tank is 48 ft. in diam. by 48 ft. high and has a cone roof. The steel firewall around the tank is 68 ft. in diam. by 24 ft. high. The firewall is made up of three rings of $\frac{3}{16}$ in. plates and a bottom ring $\frac{1}{4}$ in. thick. It rests on a concrete ring-wall $1\frac{1}{2}$ ft. wide by 4 ft. deep. The top of the firewall is stiffened by means of a wind girder made up of a $2\frac{1}{2}$ in. by $2\frac{1}{2}$ in. by $\frac{5}{16}$ in. angle and 18 steel plate sections $\frac{1}{4}$ in. thick.

Repeat installations like this tank are an indication of customer confidence in our products. We believe our continuous selection as the supplier of these tanks is based on two factors—1) the numerous advantages of welded steel tanks and 2) our ability to fabricate and erect at reasonable cost a tank that gives good service.

You can place your trust in welded construction because it offers . . . dependable oil-tightness, the joints are built tight and stay tight; economical maintenance, regular painting keeps the tank in good condition for years, and long service life—there are no sharp corners to collect dirt and invite corrosion.

You can depend on our ability because we have adequate shop fabrication facilities and the experienced erection crews to furnish good steel plate structures at an economical cost.

Horton flat-bottom storage tanks are built in standard capacities up to 11,250,000 gallons or in special sizes to meet your particular needs. Engineers responsible for specifying storage tanks or other types of steel plate structures to industry are invited to write our nearest office for estimates or quotations.

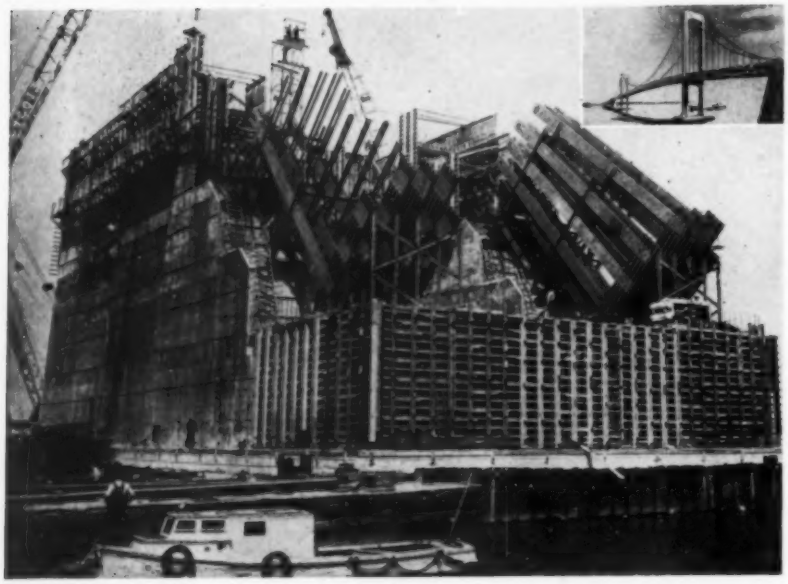
**Trademark registered at U. S. Patent Office Signature.*

CHICAGO BRIDGE & IRON COMPANY

Atlanta 3.....2167 Healey Bldg.
Birmingham 1.....1596 N. Fiftieth St.
Boston 10.....1009—201 Devonshire St.
Chicago 4.....2199 McCormick Bldg.
Cleveland 15.....2263 Guildhall Bldg.
Detroit 26.....1541 Lafayette Bldg.
Havana.....402 Abreu Bldg.
Houston 2.....2128 National Standard Bldg.
Los Angeles 17..1556 General Petroleum Bldg.
New York 6.....3395—165 Broadway Bldg.
Philadelphia 3..1652—1700 Walnut St. Bldg.
Salt Lake City 4..509 West 17th South St.
San Francisco 11..1284—22 Battery St. Bldg.
Seattle 1.....1309 Henry Bldg.
Tulsa 3.....1647 Hunt Bldg.

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PENNA.

Crossing the Delaware—1950



HUGE STEEL BEAMS TO HOLD CABLES take shape on East Anchorage Pier for Delaware Memorial Bridge (shown in artist's sketch in inset), sixth longest suspension span in world, now under construction near Wilmington. Superstructure for the pier, being built by Merritt-Chapman & Scott Corp., was up some 100 ft when this photo was taken and, when completed, will rise approximately 158 ft above river. Concrete block supporting it on river bed is largest ever built by tremie method. Completed bridge, to cost $40,000,000, will carry four highway lanes. Engineers for Delaware State Highway Department are Howard, Needles, Tammen & Bergendoff, Kansas City and New York, with O. H. Ammann, M. ASCE, and Moran, Proctor, Freeman & Mueser, New York, as consultants.

Toll Method of Financing Highways Called Unsound

OPPOSITION TO THE toll method of financing highways on the ground that the development of such roads may affect adversely the total road program was expressed by Roy E. Jorgensen, M. ASCE, deputy commissioner and chief engineer of the Connecticut State Highway Department, at the recent Third Highway Transportation Congress in Washington, D.C. "Good engineering practice," he said, "provides facilities geared to the traffic to be served and not to the method of finance."

One of the worst aspects of toll road development, the speaker emphasized, is the fact that, "not only is the alternative free road obsolete but it must remain obsolete in order that it may not compete with the toll road. . . . What of the great number of motorists on the obsolete highway, whose trips cannot be accommodated by the toll road because it does not have entrance and exit roads to serve such trips?" he inquired. Pointing out that on a toll road, entrances and exits are built only when they can pay off, Mr. Jorgensen observed, "These motorists are doomed to use the obsolete highway with no choice and with no hope for relief so long as improvement of the obsolete highway will jeopardize the financial soundness of the toll project."

Opposition was also voiced to current legislation that would increase the federal share of highway construction costs. In a panel discussion emphasizing the inadvisability of raising the present 50-50 sharing of road costs, Charles H. Buckius, M. ASCE, assistant chief engineer of the Pennsylvania Highway Department, advocated withdrawal of the federal government from the field of gasoline taxation and motor excise taxes. "These funds accruing to the states," he said, "would do more to improve the highway situation than any possible increases in federal-aid appropriations or increases in the federal share for highway construction."

The congress was sponsored by the National Highway Users Conference.

Pollution Control Policy Formed by California Body

ASKED TO FORMULATE a statewide policy for control of water pollution, the recently appointed Committee on Water Quality Criteria of the California State Water Pollution Control Board has prepared a preliminary report setting forth criteria involved in the establishment of equitable water-quality requirements. These criteria, embodying the key thesis that a water-pollution-control program must encompass both economical waste disposal and preservation of the beneficial uses of water, have been presented to the State Board for study and comment. At the present time, no legislative action has been taken on the report.

The committee that drafted the tentative water-quality criteria included ASCE members Gerald E. Arnold, director of the San Diego Water Department; A M Rawn, chief engineer and general manager of the Los Angeles County Sanitation Districts; and Edward Hyatt, state engineer. Vinton W. Bacon, Assoc. M. ASCE, is Executive Officer for the California State Water Pollution Control Board.

Mimeographed copies of the report may be obtained from the Executive Officer, State Water Pollution Control Board, State Office Building No. 1, Sacramento 14, Calif.

New Control Plan Speeds Portland Traffic Flow

INITIATION OF A one-way street plan in Portland, Ore., which is estimated to have raised the average speed of traffic flow in the downtown business district from 6 to 14 or 15 mph, is reported in a recent Bulletin of the Automotive Safety Foundation. Cited as an example of successful engineering for more efficient use of existing facilities, the one-way grid plan was put into effect recently after study and planning under the direction of Fred T. Fowler, city traffic engineer.

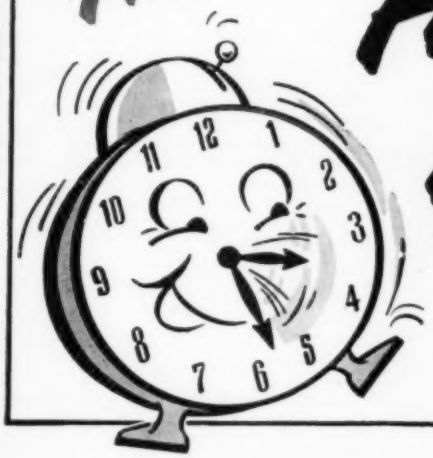
The change-over to one-way street operation, involving about 21 miles of streets, was accomplished in two steps. First, north-south avenues were marked for three moving lanes—two in the direction of future one-way movement and one for opposing traffic. Signals were re-timed for a 15-mph progression in the direction of future travel. Travel in the correct direction was made so advantageous that drivers quickly became accustomed to picking a route conforming with the one-way grid movement. After this advance training, the second step of actual change-over was made without confusion, according to Mr. Fowler.

The greater ease with which motorists can drive through the downtown business area has resulted in traffic-volume increases ranging from 5 to 105 percent and has met with general public favor, the city official stated.

Contract Awarded for Belton Dam Outlet Works

AWARD OF A $1,890,571 contract to Winston Brothers Co., of Minneapolis, Minn., for construction of the Belton Dam concrete outlet works is announced by the Galveston District of the Corps of Engineers. Construction of the $22,500,000 Belton Dam and Reservoir project, located on the Leon River, a tributary of the Brazos, is under the Galveston District. Under the terms of the present contract, approximately 44,000 cu yd of concrete and 4,000,000 lb of reinforcing steel will be used.

FASTER! FASTER! FASTER!



The Permutit® Spiractor®—last word in Cold Lime Soda Treatment—softens water in EIGHT MINUTES!

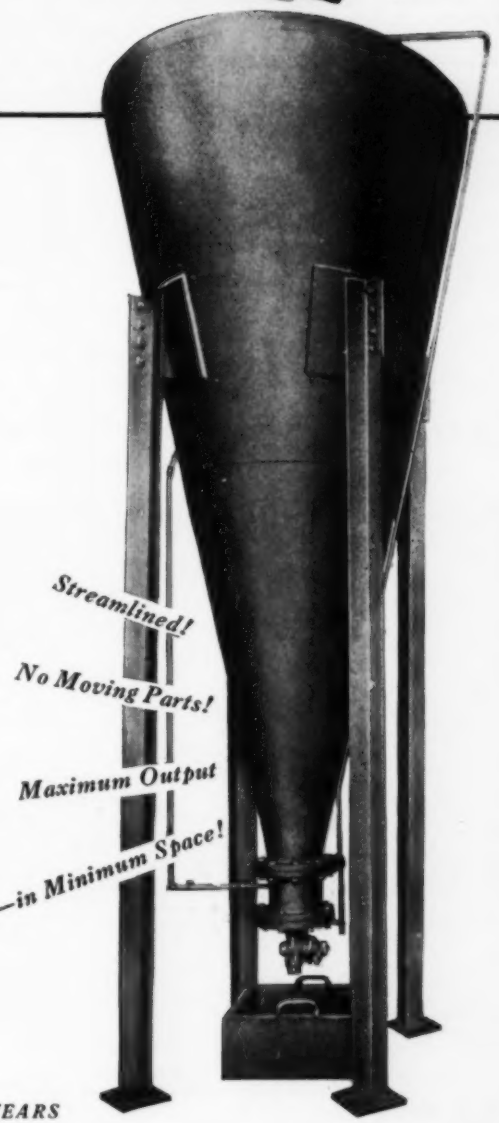
The Spiractor softens water up to 20 times faster than previous cold lime soda methods. That means you can cut your space requirements to a minimum!

Operation of the Spiractor is simple and sure: Hard water and the required lime enter at the base of the cone at a flow rate strong enough to suspend a catalyst bed of calcium carbonate granules without any carryover. The treated water is given a swirling, upward motion by being admitted tangentially to the cone.

The water softening reaction results in precipitates which are deposited on the catalyst granules by accretion. The enlarged granules are drawn off by a valve at the base.

The effluent is soft water that has a low alkalinity content and is suitable for any desired filtration.

Write for full information to The Permutit Company, Dept. CE-6, 330 West 42nd Street, New York 18, N. Y., or to Permutit Company of Canada, Ltd., Montreal.



Permutit

WATER CONDITIONING HEADQUARTERS FOR OVER 36 YEARS

Court Declares Standard Owner-Architect Contract Illegal

AN ACCOUNT OF the preliminaries in a suit on a contract by Gorden Sheill, member of the American Institute of Architects, against Reginald Howard, in the Circuit Court, County of Sanilac, Michigan, is given in the April issue of the *Journal of the American Institute of Architects*, from which the following is reprinted. The outcome and effect of this suit on architects and engineers should be watched with interest.

"The contract was prepared by Mr. Sheill on the Standard Owner-Architect Agreement Form. It involved the usual architectural services plus some landscaping. A considerable payment was made on account of the contract, disagreements resulted, and the architect sued the owner for the stated balance under the contract.

"Prior to answering the complaint, the defendant-owner moved to dismiss the complaint on the ground that suit on the contract could not be maintained since, allegedly, by its terms the contract was illegal, having been prepared by an architect and containing provision for preparation by the architect of contracts between the owner and the contractor, the said architect not being licensed to practice law, and that the use of such a contract and more particularly the undertaking in the contract to draft forms of proposals and contracts by the architect constituted and undertook the illegal practice of law.

"The portion of the Owner-Architect Agreement Form relied upon by the defendant for this motion, reads:

"'1. The Architect's Services.—The Architect's professional services consist of the necessary conferences, the preparation of preliminary studies, working drawings, specifications, large scale and full size detail drawings; the drafting of forms of proposals and contracts; the issuance of certificates of payment and the keeping of accounts, the general administration of the business and supervision of the work.'

"The Court, on this motion, made an order January 7, 1950, reading, in part, as follows:

"'A motion having been filed in this Court to dismiss the plaintiff's declaration based upon a certain contract between the plaintiff and the defendant, wherein the plaintiff contracted to 'the drafting of forms of proposals and contracts,' and, it being and appearing to this Court that the plaintiff is not a licensed attorney, and that he did draw the contract between the defendant and the contractor, and that the drawing of contracts is the practice of law, and that such part of the contract between the plaintiff and defendant is therefore illegal, the entire contract is therefore void.

"'It further appearing to this Court that due notice was given to the attorney for the plaintiff, and no person appeared in behalf of the plaintiff, the motion was heard in open Court. And, after reading the pleadings and listening to the argument of the attorney for the defendant, from which pleadings and argument it apears to this Court that the motion of the defendant is well-founded, and, on motion of Leonard J. Patterson, attorney for the defendant:

"'It is hereby ordered that Count I of the plaintiff's declaration be dismissed for the reason that it is based upon a written contract between the plaintiff and the defendant wherein the plaintiff agrees to do certain work which constitutes the practice of law, and since the plaintiff is not an attorney licensed to practice law in Michigan, such work is illegal and the contract is void.'

"After this order the Institute was notified of the status of the case by Russell Knister, attorney for Mr. Sheill. Through Messrs. Ditchy, Black and Cellarius, Counsel in Detroit, Albert Stern, was retained to assist Mr. Knister and to protect the interests of the Institute in this attack on the Standard Documents.

"Mr. Stern then proceeded to reargue the motion and submitted a brief to the Circuit Court, showing that any architect using the Standard Documents (which were prepared under legal advice) is not engaged in the practice of law as a regular activity, but is participating in fixing the relations of the owner and contractor as a technician.

"At this writing no decision on this reargument has been handed down by the Court.'

Newark Truck Terminal Expedites Traffic in Metropolitan New Jersey Area

TO REDUCE STREET CONGESTION in New Jersey–New York Port District, Port of New York Authority recently opened world's largest union motor truck terminal on 29-acre tract, north of Newark Airport and Port Newark marine terminal and adjacent to U.S. Route 1 and proposed New Jersey Turnpike, main truck arteries to metropolitan area from South and West. Built at cost of more than $8,000,000, the quarter-mile-long terminal has interior backup spaces for 160 trucks. Terminal will operate as "post office" for mechanized interchange of up to 2,500 tons of freight daily between big over-the-road truck units and smaller local pic-kup and delivery trucks, to lower handling costs and reduce truck traffic congestion in the northern New Jersey area. Similar terminal was put in operation in lower Manhattan by Port Authority last fall.

Floods Threaten Pacific Northwest, Official Says

ABOVE NORMAL SNOW accumulations in the Pacific Northwest threaten dangerous floods in the event of sudden and prolonged warm weather, according to Secretary of the Interior Oscar L. Chapman. Though most of the mountain streams in the Pacific Northwest had not begun to rise by the middle of May, Secretary Chapman predicted a large total volume of spring runoff because of the high water content of the snowpack. A gradual, orderly snow melt will result in a long but not unduly high spring peak, but prolonged high temperatures, especially if accompanied by rainfall, may cause damaging floods, he warned.

The situation on the Kootenai River in northern Idaho is critical, and flood warnings have been issued, the Secretary said, pointing out that major floods have already occurred in the North Central States and Ontario, with the "Red River of the North reported to have reached the highest stage since 1826, and peak discharge of the Missouri River at Sioux City greater than in 1943."

Cement Plant Increases Its Manufacturing Facilities

PLANS FOR CONSTRUCTION of a new $6,000,000 cement plant near Roanoke, Va., are announced by the Lone Star Cement Corp. Scheduled to be in operation early in 1951, the plant will have an annual productive capacity of 1,500,000 bbl of cement and bring to 16 the total number of mills in the Lone Star system.

Construction of a nine-mile railroad spur to serve the plant was recently completed by the Walsh Construction Co., of New York, and the Ralph E. Mills Co., of Salem, Va., who are also contractors on construction of the new plant. The silos and packhouse will be built by the Macdonald Engineering Co., of Chicago.

TANDEM DRIVE MOTOR GRADER

only **$3,585**

F.O.B. Springfield, Ill. Taxes, attachments and export preparation extra. Price subject to change without notice.

here's a value that invites comparison

Compare **THE PRICE!**
Compare **THE FEATURES!**
Compare **THE PERFORMANCE!**

...and you will agree
THE ALLIS-CHALMERS MODEL D IS YOUR BEST BUY... BY A LONG WAY

FOR SOME JOBS
On All Projects
FOR ALL JOBS
On Some Projects

ALLIS-CHALMERS MODEL D

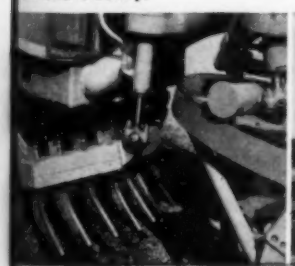
WEIGHT—8,500 lb. (base)
HP.—34.7 (Famous Allis-Chalmers gasoline engine)
SPEEDS — four forward, 2.40 to 18.61 mph.; reverse to 2.9

Not a converted job...it's ENGINEERED NEW FROM THE GROUND UP—to bring you BIG grader design and performance advantages:

- **TANDEM DRIVE**
- **TUBULAR FRAME**
- **ROLL-AWAY MOLDBOARD**
- **POWER HYDRAULIC CONTROLS**
- **COMPLETE OPERATOR COMFORT**
- **REAR ENGINE DESIGN**
- **HIGH ARCH-TYPE FRONT AXLE**
- **DROP DOWN TRANSMISSION**
- **FULL VISIBILITY**
- **SIMPLIFIED SERVICING**

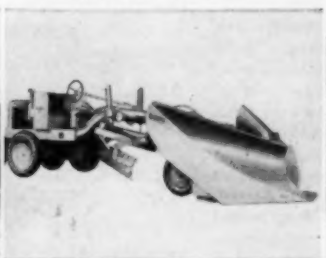
. . . Plus special attachments that widen its usefulness—Rear-End Loader, Scarifier, Windrow Eliminator, "V" or Blade-Type Snowplows. Also, various other accessories. Electric starter and lights standard equipment

HAULICALLY CONTROLLED SCARIFIER — Located back of circle for down pressure. Fast, accurate ripping, controlled penetration. Easy, positive steering resulting from great-front-end stability.

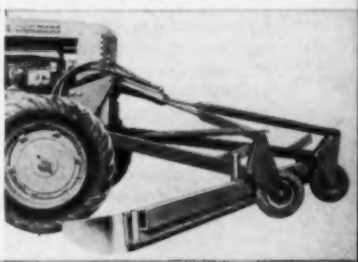


LOADS MATERIAL into trucks with Tractomotive Loader — from windrows and stockpiles . . . surplus dirt or snow. Hydraulically operated, simple to mount ⅝ cu. yd. bucket. Bucket teeth available.

PLOWS SNOW with specially designed Baker snowplows — "V" or Blade-Type. Hydraulically controlled. Interchangeable blade plow may be used for backfilling and light 'dozer work.



WINDROW ELIMINATOR SAVES TIME. This rear blade saves extra pass by feathering out windrow from grader blade. Means safer traffic conditions, too. Specially designed for the Model D.



ALLIS-CHALMERS
TRACTOR DIVISION • MILWAUKEE 1, U. S. A.

for Greater Production...
for Easier Operation...
for Simplified Servicing

"Seeing is Believing." Ask Your Allis-Chalmers Dealer for a Demonstration.

Moles Honor ASCE Members

RALPH ATWATER, ASSOC. M. ASCE, addresses annual dinner meeting of Moles, New York society of heavy construction men in New York, May 3, upon his election as life honorary president. With him (seated) is Carlton S. Proctor, M. ASCE, retiring Moles' president. New Moles' officers are James F. Salmon president; Richard V. Hyland, M. ASCE, first vice-president; David Bonner, M. ASCE, second vice-president; George P. Walker, secretary; and Howard Maxton, M. ASCE, treasurer.

Weights Anchor Pipeline for River Crossing

PRECAST REINFORCED CONCRETE weights to hold pipeline under water are readied for installation at Tennessee River crossing of Texas Gas Transmission Corp., at Owensboro, Ky. Project involved anchoring two 22-in. gas lines at point where river is 1,300 ft wide with 200 rounded river weights supplied by Universal Concrete Pipe Co., Columbus, Ohio. Blocks, cast in halves in special forms and vibrated to assure uniform strength and density, are then bolted securely over the pipe. A reinforcing bar looped through a recess in the center of each weight facilitates handling by crane or hoist hooks. Advantages of the anchors include their heavy weight which permits use of much lighter pipe than is customary, and reduces maintenance costs by providing extra protection against current.

New York City Names Experts to Study Water Supply

Five consulting water supply engineers have been named by the City of New York to recommend both immediate and long-range plans for expanding the city's water supply system. The panel of experts consists of Thorndike Saville, dean, college of engineering, New York University, chairman; W. W. Horner, consulting engineer of St. Louis; Louis R. Howson, consulting engineer of Chicago; Samuel B. Morris, chief engineer and general manager, Department of Water and Power of Los Angeles; and Abel Wolman, professor of sanitary engineering, Johns Hopkins University, Baltimore. All are members of ASCE.

Scheduled to report in November, the panel will review hydrologic and engineering data supplied by the Board of Water Supply, and those available in agencies of the State of New York and of the federal government. On the basis of the panel's report, the city is expected to decide upon sources of additional supply to meet the problem of metropolitan growth and the threat of water shortage. Possible choices are to expand the system now under construction which taps the Delaware River watershed; pump and treat water from the Hudson River; or seek other more distant sources. The City has been committed to an upland water supply.

Texas Engineers Study Modern City Problems

FAILURE TO PLAN means eventual waste, inefficiency, and often financial chaos in the life of a community, Charles B. Bennett, director of planning for the City of Los Angeles, told engineers, architects, and other professional men attending the third annual Symposium on Problems of the Modern City, sponsored by the Engineers' Council of Houston, Tex., in that city on May 6. Speaking on "Planning the Modern City," Mr. Bennett stated that, "No large corporation would think of contemplating an expansion program on an unplanned basis, yet we expect our cities to grow and expand in an orderly and efficient manner without the benefit of any blueprint or well-thought-out program. Large property owners pay the lion's share of a city's tax income. It is to their advantage to see that the physical growth of the community is related to a planned pattern that promotes the highest and best use of the land and guarantees a minimum of public expense for maintenance and upkeep thereafter."

Among other subjects on the all-day program were slums discussed as both a challenge to the city and a health hazard; the need for a sense of community in modern city life; and the metropolitan problems resulting from changes in the population structure.

Cooperating in the conference, as member organizations of the Engineers' Council, were the Houston Branch of the Texas Section of ASCE and local groups of numerous other national engineering and professional societies.

Army Corps of Engineers to Close Panama District

ANNOUNCEMENT THAT THE Panama District of the Army Corps of Engineers, largest of the 46 districts under the supervision of the Corps, will be closed June 30 is made by Maj. Gen. Lewis A. Pick, Chief of Engineers. Since its establishment in 1946, the District has directed nearly $20,000,000 of construction and maintenance work, mainly for Air Force bases and Army posts in the Canal Zone and Puerto Rico. Another major activity has been the disposal of real estate, valued at more than $100,000,000, that has been acquired for war operations.

Functions of the District have been largely completed, according to General Pick. Continuing projects in Puerto Rico will be placed under the Jacksonville (Fla.) District office.

N.J. Turnpike Authority Awards Large Contract

ANNOUNCEMENT OF THE award, on May 12, of a $5,095,733 contract to S. J. Groves & Sons Co., of Woodbridge, N.J., for work on the New Jersey Turnpike is made by Paul L. Troast, chairman of the Turnpike Authority. The contract covers grading and drainage structures, overpasses, underpasses, and stream structures on a 20-mile section from Deepwater, the southern terminus of the Turnpike, to Woodbury in Gloucester County.

Reserve Officers Trained in Disaster Relief Planning

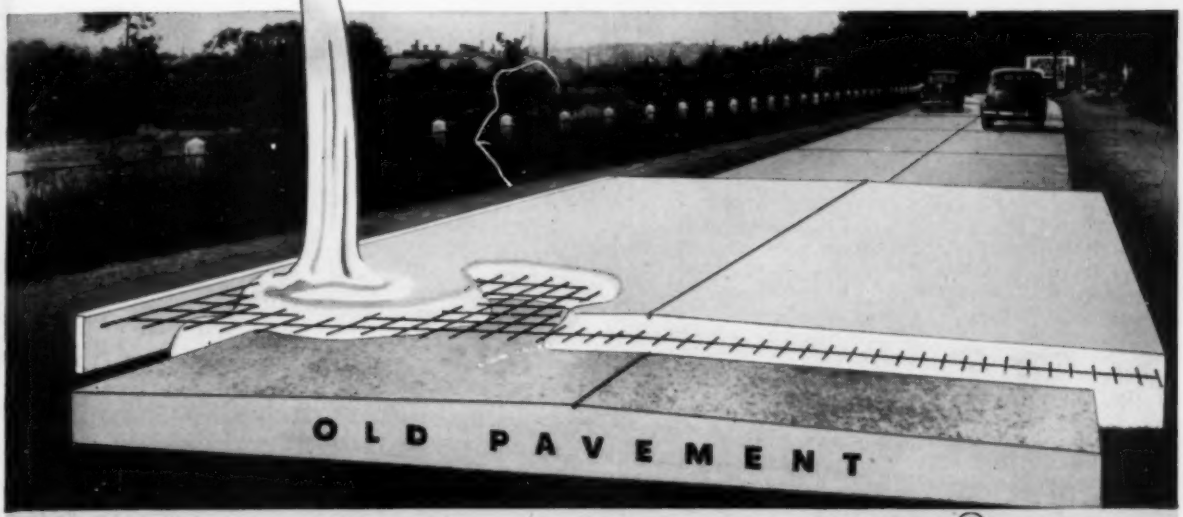
A TWO-WEEK TRAINING course in disaster relief planning and operations, conducted nine months a year by the U.S. Naval School for Civil Engineer Corps Officers at Port Hueneme, Calif., is announced by the Navy Bureau of Yards and Docks. Classes convene the third Monday of each month, except in February, September, and December.

About 200 officers of the Naval Reserve, both line and staff, have attended during the past year, with representation largely from engineering firms, contractor organizations, and engineering sections of government agencies. Information obtained is of value to the civilian concerned with the defense of his home community as well as to the Reserve officer.

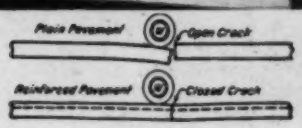
Inquires should be addressed to the Department of Defense, Office of Public Information, Washington 25, D.C.

Build New Life into old roads

with American Welded Wire Fabric



The large composite picture shows how existing roads can be widened and strengthened by resurfacing with concrete, reinforced from shoulder to shoulder with American Welded Wire Fabric. The small sketches show how Welded Wire Fabric prevents progressive damage by holding cracks tightly closed.



When your old roads prove unable to handle the increased weight and volume of today's traffic, you often can restore them to full service without incurring the excessive cost of replacing the entire road. Many highway engineers have modernized their old roads by surfacing them with concrete reinforced with American Welded Wire Fabric.

Using the old pavement as a foundation, they have built wider roadways to accommodate a greater number of vehicles. The reinforced concrete slabs are stronger — readily withstand the incessant pounding of heavy loads. A new reinforced concrete surface provides better visibility and insures greater safety than other types of resurfacing.

In resurfaced concrete roadways, the many small, closely spaced steel members of American Welded Wire Fabric fortify all parts of the slab against stresses and strains in all directions. The rate of cracking is sharply reduced and such cracks as do occur are held tightly closed, preventing progressive damage to the pavement.

When you are planning to build new life into old roads, our technical staff will be glad to supply complete data on specific designs and standard styles of U·S·S American Welded Wire Fabric that are available. Write to our nearest sales office today, you incur no obligation.

AMERICAN STEEL & WIRE COMPANY
GENERAL OFFICES: CLEVELAND, OHIO
COLUMBIA STEEL COMPANY, SAN FRANCISCO
PACIFIC COAST DISTRIBUTORS
TENNESSEE COAL, IRON & RAILROAD COMPANY
BIRMINGHAM, SOUTHERN DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

Every concrete paving job needs

AMERICAN WELDED WIRE FABRIC

reinforcement

USS

UNITED STATES STEEL

R. Robinson Rowe, M. ASCE

"I CAN HARDLY wait to tell you," said the Professor, "that the Bureau of the Census has just announced the population of Wescir, completing the series:

1900	7,117
1910	7,606
1920	8,564
1930	9,976
1940	11,864
1950	14,282

So Wescir, a community of Welsh, Scotch and Irish, has more than doubled in 50 years, but being inbred and self-sufficient, the trend should have been uniform, that is, there should have been a constant ratio between consecutive populations by decades. However the anomaly may be explained by the hypothesis that each of the three components has its own uniform trend. If so, and if the largest component is Irish, how many are there?

"There's your new problem, drawn to specifications suggested by a friend at the Los Angeles Spring Meeting—that is, there are ten hard ways and only one easy way of doing it. The April problem was of the same sort, as Guest Professor Jenney will tell you. You tell them, Dick."

"It will be obvious, Noah. Joe Kerr will show us the hard way that stumped him. Then Cal Klater, the old maestro, will show us the Euclid-Euler-Einstein method in two easy steps. Well, Joe?"

"I fooled you, Professor Jenney, using the Finagler-Kerr method. The problem was, simply, to find the distance from the center of an equilateral triangle to a point located 11, 14 and 19 cubits, respectively, from the three vertices. I drew three concentric circles with those radii and finagled with equilateral templates until the three vertices fell on the three circles. In five minutes I had the answer—five cubits!"

"Crude," scoffed Ken Bridgewater. "Precise computation is easy once the equilateral triangle is fixed, and it can be fixed by a trick. In Fig. 1, rotate BPA to the position $BP'C$, and it will follow that angle $PBP' = 60°$ and hence $PP' = 11$. Now we can compute the two angles at P', add them, and solve for BC in BCP'. It turns out to be 24.55, after which I solved two small triangles to find $PQ = 5.002$."

"Which is more precise but less accurate than Joe's work," judged Cal Klater. "I used an areal method, letting x be the unknown side and equating the areas $ABP + BPC + CPA = ABC$, which reduced to:

$$\sqrt{(x^2 - 9)(625 - x^2)} + \sqrt{(x^2 - 64)(900 - x^2)} + \sqrt{(x^2 - 25)(1089 - x^2)} = x^2\sqrt{3}$$

Knowing that x must be a little less than 25, I soon found that $x^2 = 603$ gave exactly $66\sqrt{3} + 231\sqrt{3} + 306\sqrt{3} = 603\sqrt{3}$, whence $PQ = 5$ exactly."

"Granted," concluded Professor Jenney, "but formulas would have saved you a lot of work. If a, b and c represent the eccentric distances 11, 14 and 19, and if A is the area of a triangle with sides a, b, and c (like CPP'), then the formula

$$k^2 = \frac{a^2 + b^2 + c^2}{6} \pm \frac{2A}{\sqrt{3}}$$

gives $k = AQ$ and $k = PQ$ for the upper and lower signs, respectively, that is, the one formula gives the circumradius and eccentricity. Here we have $k^2 = 113 \pm 88$, so $AQ = \sqrt{201}$ and $PQ = 5$."

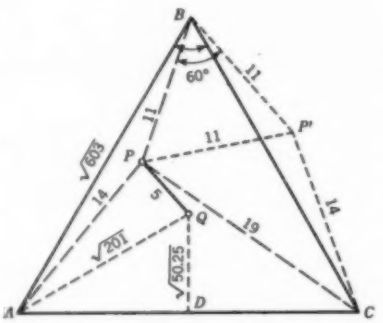


FIG. 1. GETTING started is half the problem.

"And vice versa, according to this remarkable formula, if P is outside the triangle," added Professor Neare.

[Cal Klaters were: Grant L. Davis, John L. (Stoop) Nagle, A. Nuther Nutt, Charles G. Edson, Lawrence A. Hoh, John W. Courter, G. Nyuss (Robert M. Dodds), Kum Pewter (W. Steinbruch), Julian Hinds, E. P. Goodrich, and Thatchrite (Guy C. Thatcher).]

New Agency Will Report Water Pollution Conditions

CREATION OF A new unit in the U.S. Public Health Service to supervise publication of comprehensive reports of water-pollution conditions in the country is announced by Mark D. Hollis, M. ASCE, assistant surgeon general and chief of Public Health Service engineering activities. Established as part of the Division of Water Pollution Control, the new unit is known as the Reports Analysis and Statistics Branch. Perry R. Taylor will serve as branch chief, in addition to his duties as executive officer of the Water Pollution Control Advisory Board.

Foreign Engineers Study United States Highways

A GROUP OF 45 engineers and administrators from the highway departments of 16 foreign countries have started a 16-week course of study on the theory and practice of highway improvement and utilization in the United States, which is being conducted by the Bureau of Public Roads. Formally opened on May 15 by Commissioner of Public Roads Thomas H. MacDonald, Hon. M. ASCE, the course consists of two weeks of introductory lectures and demonstrations, followed by trips to observe field construction and maintenance practices. The final weeks will be spent in Washington on specialized studies of particular interest to each delegate.

Sees Saving in Adoption of Proposed Building Code

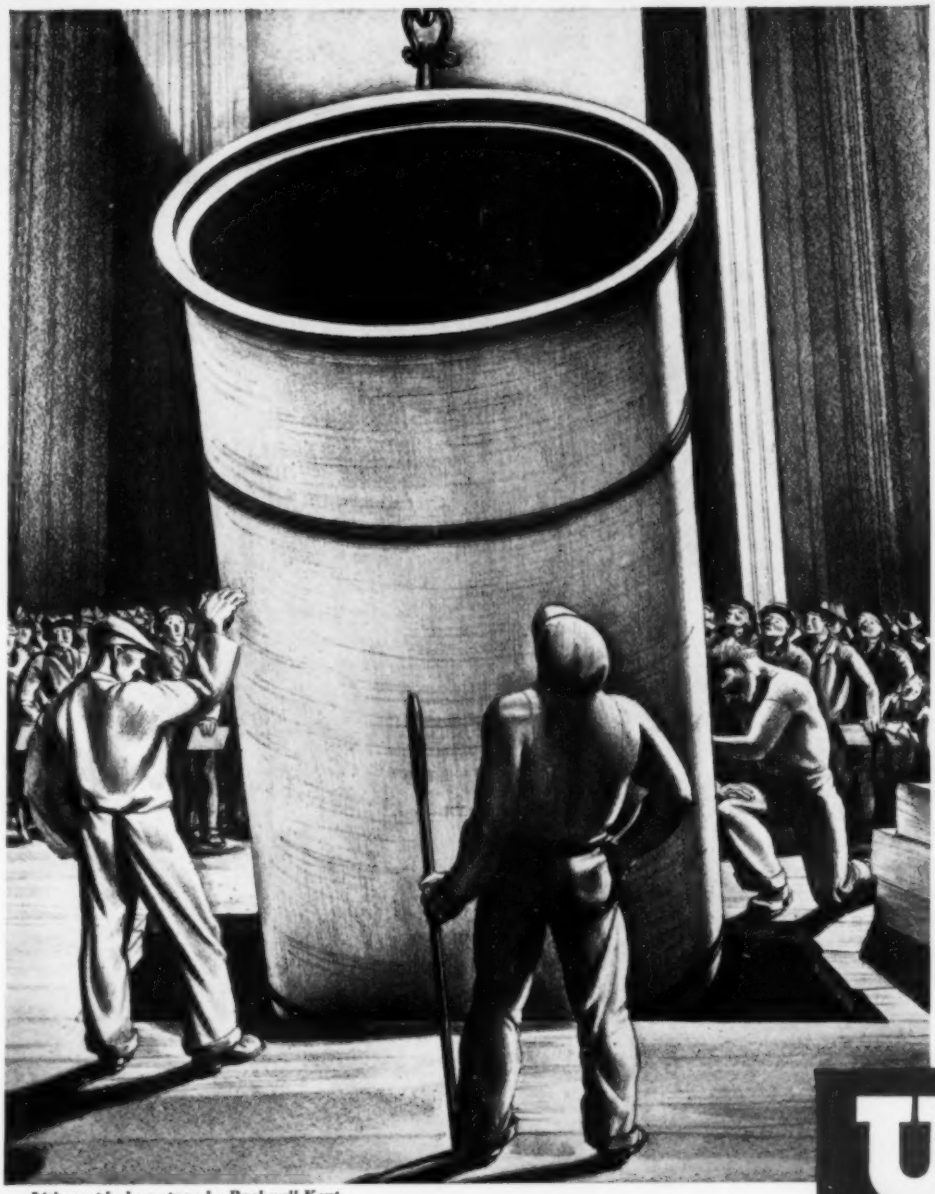
ADOPTION AND ENFORCEMENT of the proposed New York State building code will permit savings up to 10 percent on many types of construction, Edward J. McGrew, Jr., M. ASCE, chairman of the State Building Code Commission, told representatives of professional, civic, business, labor, and industrial organizations attending a public conference in New York City on May 2, arranged through the New York Building Congress.

Stating that "present restrictive, obsolete, and excessive provisions common to specification codes" are the target for modification or elimination in the Commission's program, Colonel McGrew declared "All code authorities are convinced that the specification-type codes now in force in many municipalities, must give way to the performance-type codes which readily admit new materials and techniques tending to reduce costs without sacrificing safety. The performance standards concept dominates the code work of the Commission."

The Commission has already completed a preliminary draft of a code which will apply to one- and two-family dwellings. The document will be reviewed by technical specialists and an industry-wide advisory committee before general dissemination and public hearings.

Navy Test Center to Have Instrumentation Building

ANNOUNCEMENT OF THE award of a contract for construction of an instrumentation building at the U. S. Naval Air Missile Test Center, Point Mugu, Calif., to the Al-Co Co., of Los Angeles, is announced by the Bureau of Yards and Docks. In general, the project consists of building a single-story reinforced concrete structure, 100 × 260 ft, with a five-story tower section 22×44 ft. The contract price for the work is $461,895, and the contract time for construction 270 calendar days.



Lithographed on stone by Rockwell Kent

U.S.
cast iron
PIPE
FOR WATERWORKS, SEWERAGE AND INDUSTRIAL SERVICE

"Meet the customers' needs" has been our watchword for more than fifty years. Whether it's pipe seven feet, or a few inches, in diameter—or a complicated fitting—or a special casting—we have the equipment and the technical skills to meet almost any need for cast iron pressure pipe and fittings. Taking advantage of process developments and utilizing scientific methods to control quality, our plants are regularly manufacturing products that adequately meet our customers' exacting requirements. **United States Pipe and Foundry Company, General Offices: Burlington, N. J. Plants and Sales Offices Throughout U. S. A.**

CHAMPION of C

Contractors and Operators throughout the Country Proclaim the New TD-24 CHAMPION of Crawlers

The International TD-24 has proved itself CHAMPION of Crawlers. On job after job, the new TD-24 has won the admiration of operators for the ease with which it does work which other tractors cannot do. Contractor-owners are equally enthusiastic, for they see the TD-24 outworking and out-producing every other tractor in the field.

Greater power, and the weight and traction to match, plus new operator convenience and ease of control, give the TD-24 much more than an edge over any other tractor you might name.

Experienced operators and owners have this to say about the new TD-24: (names on request)

"In my estimation the TD-24 is the heavyweight champion of crawler tractors."

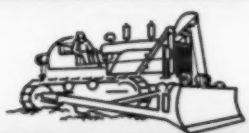
"The TD-24 works right along on slopes so steep we have to cut them down before other tractors can even navigate unloaded. TD-24's are fast tractors, easy to shift and have plenty of power. This combination really moves dirt . . . made us more money than any other tractor could."

"The TD-24 is a wonderful piece of machinery and I can't say enough for it. Our operators feel they are wasting their time when they run other tractors, for no other tractor built can compare with the work these TD-24's can do."

Visit your International Industrial Power Distributor and see what the TD-24 can do for you. You'll agree it's the CHAMPION of Crawlers—the one tractor you can't afford to be without, for profitable earthmoving.

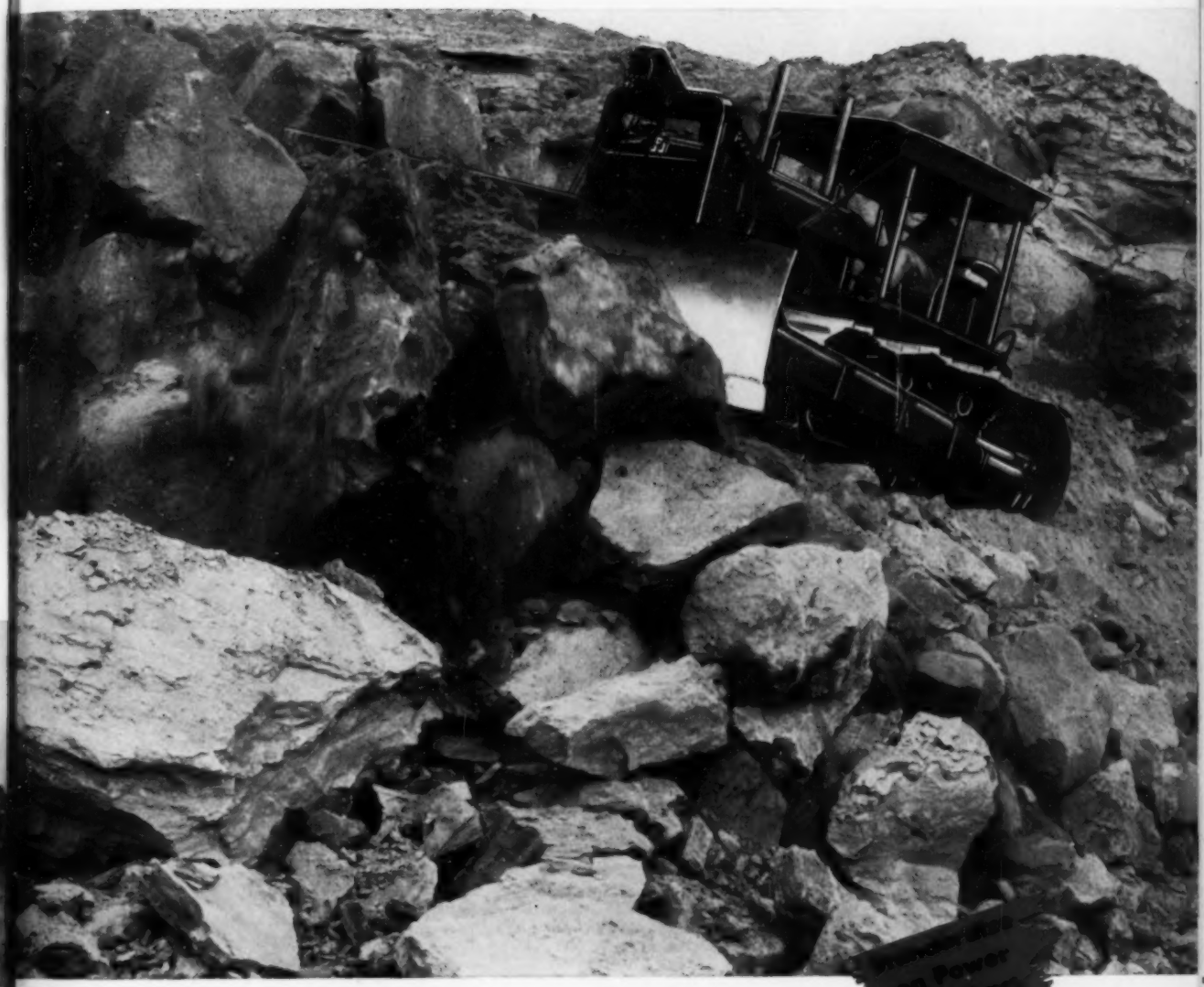
INTERNATIONAL HARVESTER COMPANY
Chicago

JOB FOREMAN REPORTS SAVINGS
"It (the TD-24) is definitely outhauling every other tractor on the job," says the foreman on this 247,000-yard stadium bowl job in Maryland. "It will do so much work that we are sure our job costs will show a great saving."



f Crawlers

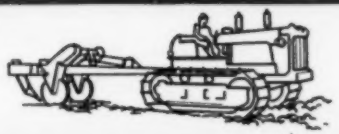
"Worth Two of Any Other Heavy Tractor," says Lindsey Belville, president of Greasy Ridge Coal Co., Greasy Ridge, Ohio, strip mine. "This is the best tractor I've ever used in my five years experience," says Warren Bare, the tractor operator shown working it in heavy rock. "It is the only one that will do everything I want it to," he claims.



INTERNATIONAL HARVESTER

INTERNATIONAL
INDUSTRIAL POWER

CRAWLER TRACTORS • WHEEL TRACTORS • DIESEL ENGINES • POWER UNITS



NEW IN Education

ADVANCED TRAINING IN irrigation engineering will be given at Colorado A. & M. College in summer sessions beginning June 19. Ivan D. Wood, irrigation engineer for the Soil Conservation Service, Denver, Colo., and M. R. Lewis, M. ASCE, chief of the Division of Irrigation Operations, Branch of Operations and Maintenance, Bureau of Reclamation, Washington, D.C., will serve as visiting professors. Inquiries should be addressed to T. H. Evans, Dean of Engineering, Colorado A. & M. College, Fort Collins, Colo.

A GRADUATE RESEARCH fellowship in the forest products field is being offered by the Michigan College of Mining and Technology. Students holding a B.S. degree from a recognized college or university in the United States or Canada are eligible to apply. The award, which carries a stipend of $1,200 plus exemption from tuition and most fees, will be made for half-time research in the area on wood utilization, under the direction of the Forest Products Research Division of the college. Applications should be directed to the Chairman of Scholarship Committee, Michigan College of Mining and Technology, Houghton, Mich.

THE THIRD ANNUAL Pennsylvania Sewage Works School and the third annual Pennsylvania Water Works School will be conducted at Pennsylvania State College, June 19–23 and June 26–30, respectively. Elementary, intermediate, and advanced courses will be offered in each of the schools. Complete information can be obtained from R. E. Stiemke or R. R. Kountz, Department of Civil Engineering, Pennsylvania State College, State College, Pa.

TO FURNISH MAXIMUM aid to young practicing engineers in the Harrisburg area, a graduate course in advanced structural theory is being offered off-campus for the first time this year by the Pennsylvania State College at its Harrisburg Center. J. B. Liebsch, Assoc. M. ASCE, bridge engineer with the Philadelphia Department of Public Works, will be the instructor. For further information write to Thos. Hammonds, General Extension Editor, Pennsylvania State College, State College, Pa.

(*Continued on page 75*)

Deceased

Oscar S. Bowen, Former Vice-President, Dies

OSCAR SIDNEY BOWEN, retired engineer and Vice-President of ASCE in 1924 and 1925, died at his home in Wenatchee, Wash., on April 13 after a long illness. Mr. Bowen, who was 83, had been a full Member of the Society since 1909.

Oscar S. Bowen

Except for brief periods in private practice, he spent most of his career in railroad work—from 1901 to 1939 on the staff of the Great Northern Railway. In his connection with the Great Northern, Mr. Bowen served as assistant chief engineer in the Seattle office and assistant to the chief engineer at St. Paul, Minn. He was in charge of planning and supervision of heavy construction work on a number of tunnels, bridges, snowsheds, and other structures, and later was in charge of valuation work for the line. Following his retirement from railroad work in 1939, Mr. Bowen had a consulting practice in Seattle for a while.

Fred Asa Barnes (M. '22) professor emeritus of railway engineering at Cornell University, died at his home at Pleasant Valley, Conn., on April 5, at the age of 73. A graduate of Cornell, Professor Barnes served on the faculty there from 1902 until his retirement in 1946—as professor of railway engineering from 1915 on, and director of the School of Engineering from 1921 to 1930. Earlier he had been in the district engineer's office in Washington, D.C., and in the Navy's Hydrographic Office in Cuba. Professor Barnes was author of numerous articles on transportation and co-author, with Prof. C. L. Crandall, of a text, *Railroad Surveying and Railroad Construction*.

Casper Marshall Durgin (Assoc. M. '28) for the past 30 years with the U.S. Coast and Geodetic Survey in Washington, D.C., died there on March 11, at the age of 53. A graduate of Harvard University, he had commanded survey ships in various territorial waters, and at the time of his death, headed the charts division of the Survey. During the war, Mr. Durgin served with the Navy in the Alaskan area.

Carl Adam Hechmer, Sr. (M. '38) department engineer for the Washington Suburban Sanitary Commission, Hyattsville, Md., died on November 24, 1949, according to word just received at Society Headquarters. Mr. Hechmer, who was 54, had been with the Washington Suburban Sanitary District since 1919. He also engaged in private practice as a sanitary engineer, specializing in swimming pool design and operation. Active in the American Water Works Association, Mr. Hechmer had been secretary-treasurer of a four-state section of the organization and received its George W. Fuller Award in 1940. He was a graduate of the Baltimore Polytechnic Institute.

George Hammeken Hill (M. '18) who headed the contract department of the West Virginia State Road Commission, Charleston, W.Va., died at his home there on March 20. Mr. Hill, who was 83, held the longest service record with the Commission. Before going to Charleston in 1917, he had been city engineer and treasurer of Bluefield, W.Va., and he was a charter member of the Bluefield Chamber of Commerce. He graduated from the University of Pennsylvania in 1889.

Stephen Ephraim Kieffer (M. '07) consulting engineer of Los Altos, Calif., died on December 19, 1949, at the age of 81. Mr. Kieffer was a graduate of Bucknell University in 1888, and later did postgraduate work at Massachusetts Institute of Technology. He had been chief engineer in charge of the design and construction of four irrigation districts in California in a $4,000,000 construction program; in charge of the complete municipal housing project for the U.S. Housing Corp. at the Mare Island Navy Yard; and consulting engineer for the Western Pipe & Steel Company of California, San Francisco, on extensive hydrographic studies for the Mokelumne and other projects. He had been in general practice since 1941.

Edward Harrison Ruffin (Assoc. M. '49) vice-president of the Baltimore, Md., consulting firm of Faisant & Kooken, Inc., died in a hospital in that city on March 21. He was 35. A graduate of Virginia Military Institute, class of 1939, Mr. Ruffin was with the Baltimore District of the U.S. Engineer Department from then until 1946, except for a four-year period in the Army. He held the rank of captain in the Field Artillery, serving in this country and in the European campaign. He became connected with Faisant & Kooken in August 1946.

Walter Fleming Scofield (Assoc. M. '42) associate professor of civil engineering at the University of Alabama since 1946, died suddenly at his home at Tuscaloosa, Ala., on April 19. He was 39. A graduate of the University of Kansas, Professor Scofield had taught there and at Rice Institute and Tulane University, and for four years was with the Kansas State Highway Department. At the time of his death, he was consulting engineer for the Alabama State Planning Board and for the Southern Lumber Association.

Darwin Wadsworth Townsend (M. '25) member of the Chicago firm of Consoer, Townsend & Associates, died at his home in Milwaukee, Wis., on March 13. He was 62. An authority on the design and construction of sewerage facilities, Mr. Townsend served the Sewerage Commission of both the City and County of Milwaukee for 20 years as engineer of design, principal assistant engineer, and acting chief engineer on disposal projects totaling $34,000,000. He was expert sanitary engineer witness for the State of Wisconsin in litigation on the diversion of Great Lakes water, and author of numerous engineering reports in his field. Mr. Townsend was co-inventor,

(*Continued on page 74*)

And now it's STEEL BRIDGES

for the WESTERN Extension of the Pennsylvania Turnpike

STEEL BRIDGES
FOR THE EASTERN EXTENSION
OF THE
PENNSYLVANIA TURNPIKE
PITTSBURGH
IRWIN
HARRISBURG
PHILADELPHIA
The Steel Bridges shown below are on the existing Turnpike—those for new extension will be of similar type.
AISC
"Steel Permits Streamlining Construction With Safety, Endurance and Economy."
Because of the excellent service records made by the Steel Bridges on the present Pennsylvania Turnpike—when the extension was planned it was decided to again specify STEEL BRIDGES. Many of these, too, will be fabricated by Fort Pitt Bridge.
Fort Pitt BRIDGE WORKS
Member American Institute of Steel Construction
General Offices, Pittsburgh, Pa. • Plant at Canonsburg, Pa.
BRANCH OFFICES
New York, N.Y., 441 Lexington Avenue · Columbus, Ohio · Huntington Bank Bldg.
Cleveland, Ohio · · Bulkley Building · Detroit, Michigan · New Center Bldg.

When this Western Extension is completed, over 20,000 tons of steel bridges on this section will carry the Turnpike over rivers, highways and crossroads over and under this Super Highway. When finished, this great highway will stretch from border to border of the state without a single crossing intersection—thanks to a series of steel bridges. With 54 years of experience in all phases of bridge building, Fort Pitt Bridge is the logical choice for the fabrication and erection of many of these steel bridges.

FORT PITT BRIDGE WORKS

Member American Institute of Steel Construction

General Offices: Pittsburgh, Pa. • Plant at Canonsburg, Pa.

Branch Offices: NEW YORK, N.Y., 441 Lexington Avenue · CLEVELAND, OHIO, Bulkley Building · COLUMBUS, OHIO, Huntington Bank Bldg. · DETROIT, MICHIGAN, New Center Bldg.

(*Continued from page 72*)

with James Brower, superintendent of the Milwaukee Sewage Treatment Plant, of sludge-collecting apparatus, designated Tow-Bro in their honor.

John Norman Spencer Williams (M. '10) of Honolulu, Hawaii, died there in February, at the age of 92. Born and educated in England, Mr. Williams was employed at St. John, New Brunswick, and in San Francisco before going to Hawaii in 1890. A specialist in all branches of the manufacture of raw cane sugar, Mr. Williams built numerous factories and railroads serving the industry—for a number of years as consulting engineer and director of T. H. Davies & Co. in Honolulu.

Engineering Societies PERSONNEL SERVICE, INC.

NEW YORK 8 W. 40th ST. • CHICAGO 84 E. RANDOLPH ST. • DETROIT 100 FARNSWORTH AVE. • SAN FRANCISCO 57 POST ST.

This placement service is available to members of the Four Founder Societies. If placed as a result of these listings, the applicant agrees to pay a fee at rates listed by the service. These rates—established to maintain an efficient non-profit personnel service—are available upon request. The same rule for payment of fees applies to registrants who advertise in these columns. All replies should be addressed to the key numbers indicated and mailed to the New York Office. Please enclose six cents in postage to cover cost of mailing and return of application. A weekly bulletin of engineering positions open is available to members of the cooperating societies at a subscription rate of $3.50 per quarter or $12 per annum, payable in advance.

Men Available

CHIEF MATERIALS ENGINEER OR CONSULTANT; Assoc. M. ASCE; 43; married; registered civil and mechanical engineer, California; 20 years' experience and training in proper use of many engineering materials, research, development, testing, design, static and dynamic stress analysis, costs, and construction or manufacture. Ph.D. in applied mechanics of materials; business and personnel training. Prefers California. C-601-456-D-3.

CIVIL ENGINEER; Jun. M. ASCE; B.S. in C.E.; single; veteran; 2 years' experience as field engineer on oil refinery layout work for all types of refinery construction; registered land surveyor, Indiana. Desires employment with engineering or construction firm. Interested in becoming construction engineer; willing to work in field or office. Prefers North or middle Atlantic location. C-602.

CIVIL ENGINEER OR PROFESSOR; M. ASCE; 49; married; Ph.D. 1926, Cornell University; 25 years' experience designing engineer, professor, dean of engineering, chief engineer, consulting engineer, executive of river commission; both American and Chinese experience. Specialization, hydraulic, structural, and transportation engineering. Desires position as professor, planning or research engineer in United States. C-603.

CIVIL AND INDUSTRIAL ENGINEER; Jun. M. ASCE; 31; P.E., New York; B.S., M.S. in C.E.; course work for doctorate in I.E. completed; a year's structural design; 3 years A.I.S.C. research; a year's technical investigations; 4½ years teaching structures, concrete materials testing, etc. Knows French, German. Desires position with future. C-604.

ENGINEER; Jun. M. ASCE; B.S. in M.E., Stevens Institute of Technology; graduate work structural design and soils, Newark College of Engineering and Columbia University; 3 years in machine shop and metal fabricating plant as design and special sales representative; 3 years teaching, 2 of which were in design of timber, steel, and reinforced concrete structures. Supervision experience. Desires position in plant engineering in northern New Jersey or New York City. C-605.

CIVIL ENGINEER; Jun. M. ASCE; 27; single; veteran; B.S. in C.E., January 1950; summer experience with New York State Highway Department. Desires position as junior engineer with construction company doing field or office work. Available immediately. Domestic or foreign service optional. C-606.

CIVIL ENGINEER; Jun. M. ASCE; 30; single; graduate; 3 years' experience structural analysis; 3 years supervision of general construction, utilization of heavy equipment, maintenance of buildings and grounds, including substantial administration; fluent German; desires overseas position or one requiring considerable travel outside the United States; available immediately. C-607.

STRUCTURAL ENGINEER; Jun. M. ASCE; 25; B.S. and M.S. in civil engineering; 2 years' teaching experience, 1 year half-time research, 1 year bridge design. Desires position with consulting firm or contractor in building field. C-608.

Positions Available

PROFESSOR in highway engineering with some practical experience. Spanish desirable, but not necessary. Salary, $6,000 a year plus living allowances and travel expense. Location, Venezuela. Y-3411.

CIVIL ENGINEER, 30–40, with construction experience covering highway, railroad, drainage, etc., for sugar mill plantation. Previous experience in Central America desirable. Salary, $5,000–$6,000 a year. Location, Caribbean area. Y-3434.

CIVIL ENGINEER, young, with contracting experience, to supervise construction of small buildings with a native staff, and work with contractors on some larger extensions. Considerable maintenance and rebuilding necessary. Duration 2 years, with possibility of permanent position. Salary, $6,000–$7,000 a year. Single status to start. Location, India. Y-3442.

SANITARY ENGINEER, about 35, with experience in design of sewage treatment facilities, and familiar with industrial-waste problems, to make surveys of industrial- and sanitary-waste problems in the field and translate into practical treatment facilities. Salary to start, $5,000 a year. Location, Indiana. Y-3489C.

ASSISTANT PROFESSOR OR INSTRUCTOR, civil graduate, preferably with M.S. degree and P.E. license, under 40, to teach: (*a*) Structural Engineering, (*b*) Soil Mechanics and Foundations, and (*c*) Sanitary Engineering. Salary, $2,900 a year minimum. Location, New York metropolitan area. Y-3499.

SOILS ENGINEER with 1 to 3 years' experience, preferably in setting up laboratory for highway construction job. Salary, $3,600–$4,800 a year. Location, southern New Jersey. Y-3520.

CONSTRUCTION SUPERINTENDENT, 30–40, engineering graduate, with industrial construction and processing equipment installation experience, to coordinate field engineering and construction activities covering foundation, building, electric power wiring, piping, process equipment, refrigeration. Some traveling. Salary, $5,200 a year. Location, East. Y-3522.

DESIGNERS AND ENGINEER-DRAFTSMEN. (*a*) Engineer-Designer, experienced in design of reinforced concrete, structural steel in buildings and structures, with a good background in civil and sanitary projects. (*b*) Engineer-Draftsman, with good background in civil, sanitary and highway work. Positions are for consulting engineers in the field of industrial buildings, water and sewerage, both distribution and plants, highways, airports, etc. Location, South. Y-3542-R-6421.

DESIGNER, civil graduate, with at least 3 years reinforced concrete experience, to design and layout concrete foundations, storage silos and general heavy construction. Salary, $3,900–$4,160 a year. Location, New York, N.Y. Y-3577.

ESTIMATOR with minimum of 10 years' experience, to take-off quantities, price masonry, concrete and carpentry, and to perform other general estimating duties. Salary, $6,500–$7,800 a year. Location, northern New Jersey. Y-3584.

PLANT MANAGER for medium-sized privately owned water utility. Must have extensive experience in the management, operation, maintenance, and accounting practices of a water plant. Must have good technical background and be capable of planning improvements. Must be fully qualified to take over the operation of the plant without training or indoctrination. Salary open. Location, New York State. Y-3586.

CHIEF CONSTRUCTION ENGINEER, civil engineer, 10 to 20 years' experience in charge of construction and operation of modern sewage treatment plants and water purification plants and preferably additional experience in construction and operation of small steam power plants. Assist partner and must be able to handle plenty of responsibility for a consulting engineer. Salary, $500 a month. Location, Illinois. R-6344.

DESIGNERS (structural steel), 3 or 4; experienced in powerhouses and industrial type construction, for a consulting engineer. Salary, $4,680–$5,874 a year. Location, Illinois. R-6398.

STANDARDS DIVISION SUPERVISOR, M.E.; minimum 15 years' experience ordnance and manufacturing standards field including design and production drafting, mechanisms, engineering materials, some chemistry and metallurgy, familiarity with standardization in electronics desirable. Must be specialist in ordnance and commercial standards. Salary open. Location, Southwest. R-6401.

PROJECT FIELD ENGINEER, civil, with substantial experience locating pipelines, run levels, secure data for mapping, and locate and layout with a minimum of supervision for a public utility. Travel through North Midwest States. Salary, $6,000 a year. Headquarters, Chicago, Ill. R-6404.

DESIGNER-STRUCTURAL OR ARCHITECTURAL, technology graduate 35 up; 10 years' experience with design of industrial and public buildings. Must be capable of taking complete charge of structural engineering drawing room of 6 designers and draftsmen. Salary up to $6,000. Location, Illinois. R-6419.

ARCHITECTURAL ENGINEER, graduate, 24–35; a year or more experience in architectural design. Will design for sales display offices; prepare working drawings, specifications, estimates on remodeling and new construction. Knowledge of interior decorating, lighting, and display equipment desirable. Salary, $3,000–$4,000 a year. Location, Illinois. R-6426.

RESEARCH DEVELOPMENT ENGINEER, 30; C.E. Practical experience or graduate work at master's level in concrete. Will make tests, prepare reports, carry on research and development, construct special test specimens, make exposure tests, and determine qualities of concrete and cement for road construction purposes. Salary, $5,000–$6,000 a year. Location, Illinois. R-6429.

RESEARCH AND DEVELOPMENT ENGINEER, some experience in design and use of equipment for bloating shale and clay for lightweight aggregates in concrete (similar to rotary kiln and the sintering machine). Salary open. Location, Illinois. R-6431.

(*Continued from page 72*)

A RECENT ALL-DAY conference on soil mechanics and foundation engineering at the University of Kansas was attended by approximately 150 engineers from Kansas and nearby states. Prof. G. W. Bradshaw, Assoc. M. ASCE, served as chairman of the conference, which was sponsored by the school of engineering and architecture.

DEVELOPED IN COLLABORATION with an advisory board of industrial leaders, a new training program in salesmanship for engineers will start June 19 at the City College of New York School of Business. Further information may be obtained by writing to the Supervisor of Admissions, City College Midtown Business Center, 430 West 50th Street, New York 19, N. Y.

THE UNIVERSITY OF Utah recently observed the 100th anniversary of its founding. Speakers on the four-day program included J. B. Lee, the governor of the state, and a distinguished list of educators from universities all over the country. ASCE was represented at the ceremonies by George P. South, president of the Intermountain Section. Concerts, a symposium on education, and a Founders' Day banquet and ball were among the events.

NEWS OF Engineers

William Mack Angas, rear admiral, CEC, USN, director of the Atlantic Division, Bureau of Yards & Docks, has retired after a career of 32 years. He has accepted a post as chairman of the civil engineering department at Princeton University. In addition to his duties as director of the Atlantic Division, Admiral Angas served as a member of the staff of Commander Eastern Sea Frontier and was responsible for construction of berthing facilities for Reserve Fleet vessels in Atlantic Coast and Gulf ports.

Admiral Angas

Donald N. Becker, since 1948 chief structural engineer for A. J. Boynton & Co., Chicago, Ill., consultants, has been appointed to the Illinois Structural Engineering Examining Committee, succeeding the late **Isaac F. Stern.** Mr. Becker received the Thomas Fitch Rowland Prize in 1946.

Andrew F. Moursund, after 28 years of service with the Texas Highway Department, has retired as district engineer at San Angelo. **Leslie D. Cabaniss,** formerly assistant engineer at Paris, has been trans-

(*Continued on page 76*)

New, Complete
DOOR DATA

Space-Saving • Time-Saving • Doors for every need

You'll have full information on cost-cutting doors for every need in this complete new Kinnear catalog. For example, it presents:

Kinnear Rolling Doors. The famous interlocking steel-slat doors—*originated by Kinnear*—glide smoothly, easily upward, coiling out of the way overhead. They save floor and wall space. All-metal construction assures extra years of low-cost service, protection against fire, storm, intrusion, and accidental damage. Available with Kinnear motor operators and push-button control.

Kinnear Rolling Fire Doors. The famous "Akbar" Fire Door, similar to doors above, but featuring automatic closure in case of fire, with safety for building occupants.

Kinnear Rol-TOP Doors. Section-type upward-acting doors, of either wood or all-metal construction. Paneled for glass as desired.

Kinnear Bi-Fold Doors. Two-section doors of wood or metal that "jacknife" to overhead position. Paneled for glass as desired.

Kinnear Rolling Grilles. Sturdy upward-coiling curtain of interlocking steel bars and links that protect property without blocking light, vision, or sound. Any size.

Send for FREE catalog today.

The KINNEAR Manufacturing Co.
1880-90 Fields Avenue, Columbus 16, Ohio
1742 Yosemite Ave., San Francisco 24, Calif.
Offices and Agents in All Principal Cities

Saving Ways in Doorways
KINNEAR
ROLLING DOORS

(*Continued from page 75*)

ferred to the Pecos District of the department.

Lorenz G. Straub, director of St. Anthony Falls Hydraulic Laboratory and head of the department of civil engineering at the University of Minnesota, was honored with the French medal of academic palms while in New York to address the French Society of Engineers. Dr. Straub was previously awarded the Officer d'Academie diploma from the French government.

L. G. Straub

Charles O. Gunther, professor of mathematics and ordnance engineering and head of the department of mathematics at Stevens Institute of Technology, will retire September 1 upon his completion of 50 years as a faculty member.

Gordon H. Bannerman, formerly connected with the American Steel & Wire Co., of New Haven, Conn., has been appointed manager of wire rope, aerial tramways, and suspension bridges for Columbia Steel Co., of San Francisco, Calif.

L. C. Campbell and **Kenneth P. Norrie** have formed a partnership for the practice of civil engineering, with offices at Spokane, Wash.

Herman F. Bahmeier, since 1930 construction engineer with the Bureau of Reclamation at Davis Dam, Nev., has been appointed to the Delta District of the Central Valley project, where he will direct the organization's construction work on the American River development.

Paul E. Middleton, who recently resigned as director of the Indiana Economic Council, is now a consulting engineer for the Federal Slum Clearance and Urban Redevelopment Commission in Washington, D.C.

Charles M. Upham, whose resignation as engineer-director of the American Road Builders' Association, Washington, D.C., after 24 years of service, was announced in the April issue of CIVIL ENGINEERING, has established an office in Washington, D.C., for engineering practice. He will specialize in reports, research, economic studies, appraisals, investigations, plans, surveys, and finance consultation. He will also have close liaison with government departments, international representation, and specific information service.

Sidney Smith, with the U.S. Geological Survey at Sacramento, Calif., has been assigned to field duty in Utah.

Robert Stevenson, of the Sacramento, Calif., office of the U.S. Geological Survey, has been transferred to Placerville, Calif., where he will be in charge of Survey mapping in that vicinity.

Henry Walsh, former assistant division engineer for the North Atlantic Division of the Corps of Engineers, has been appointed district engineer at Nashville, Tenn. Colonel Walsh is a veteran of 29 years of service in the National Guard Reserve and the U.S. Corps of Engineers.

R. J. Putney, who has been flood control engineer for Harris County, Texas, is opening a consulting engineering office in Houston.

Russell C. Brinker, previously associate professor of civil engineering at the University of Southern California, has been named professor of civil engineering at Virginia Polytechnic Institute, effective September 1. **R. B. H. Begg,** who has been on the VPI faculty for 37 years, has retired.

The firm of **Michael Baker, Jr., Inc.,** with headquarters in Rochester, N.Y., recently celebrated its tenth anniversary in the fields of engineering, planning, and surveying. It is currently making the topographic surveys and preparing contoured and uncontoured aerial mosaics of the Kissimmee River Valley (Florida) for the Jacksonville Corps of Engineers' Central and Southern Florida Flood Control Project.

Formation of Fort Worth Engineer District Announced

CREATION OF A new Corps of Engineers District at Fort Worth, Tex., to control Texas rivers is announced by the Army Corps of Engineers. Covering about two-thirds of the state and small portions of Louisiana and New Mexico, the new Fort Worth District will be responsible for flood control, water conservation, and allied purpose projects. At the present time the new Engineer Office is supervising the construction of eight major flood control projects at a cost of $175,000,000. Appointed to head the new Fort Worth District is Lt. Col. Delbert B. Freeman, formerly on a tour of duty with the Far Eastern Command of the Corps.

Lt. Col. Freeman

Wilson V. Binger, formerly chief soils engineer with Parsons, Brinckerhoff, Hall & Macdonald in Buenos Aires, Argentina, has joined the general contracting firm of Porterfield & Binger Construction Co., of Youngstown, Ohio, as vice-president. Mr. Binger is also maintaining his own consulting practice in Youngstown.

Leo O. Colbert, who has been with the U. S. Coast & Geodetic Survey for the past 42 years, recently as director in Washington, D.C., has retired. Admiral Colbert has directed many coast surveys in the Philippines. **Rear Admiral Robert F. A. Stubbs** will succeed Admiral Colbert as director.

R. T. Conway, field engineer for Ragnar Benson, Inc., of Chicago, Ill., will have charge of the firm's contract for construction of an International Harvester depot at Atlanta, Ga.

Wright Hiatt, lieutenant colonel, Army Corps of Engineers, has been appointed deputy chief of the Civil Works for Flood Control in the Office of the Army Chief of Engineers, at Washington, D. C. He succeeds **Lt. Col. Herbert C. Gee,** who has entered private engineering practice in West Palm Beach, Fla.

Linne C. Larson is now executive officer of the Regional Water Pollution Control Board No. 4 of California, with headquarters in Los Angeles. Mr. Larson was formerly associated with the consulting concern of Taylor & Taylor. Active in the Society, he is serving as vice-president of the Los Angeles Section.

Ray K. Linsley, Jr., for the past five years head of the Hydrologic Branch of the U.S. Weather Bureau, Washington, D.C., is now associate professor of hydraulic engineering at Stanford University.

Charles R. Foster, since 1946 assistant chief of the Flexible Pavement Branch of the Soils Division of the Waterways Experiment Station, Corps of Engineers, at Vicksburg, Miss., has been appointed chief.

(*Continued on page 78*)

Joint ASCE–EIC Summer Convention
Toronto, Ontario, Canada
Hotel Royal York, July 12–14, 1950

(*Please Print*)

Name.....

Street.....

City.....Zone.....State.....

Mail to:
The General Secretary
Engineering Institute of Canada
2050 Mansfield Street
Montreal 2, Quebec, Canada

Please reserve for my occupany the following hotel accommodations:

Double.....Single.....

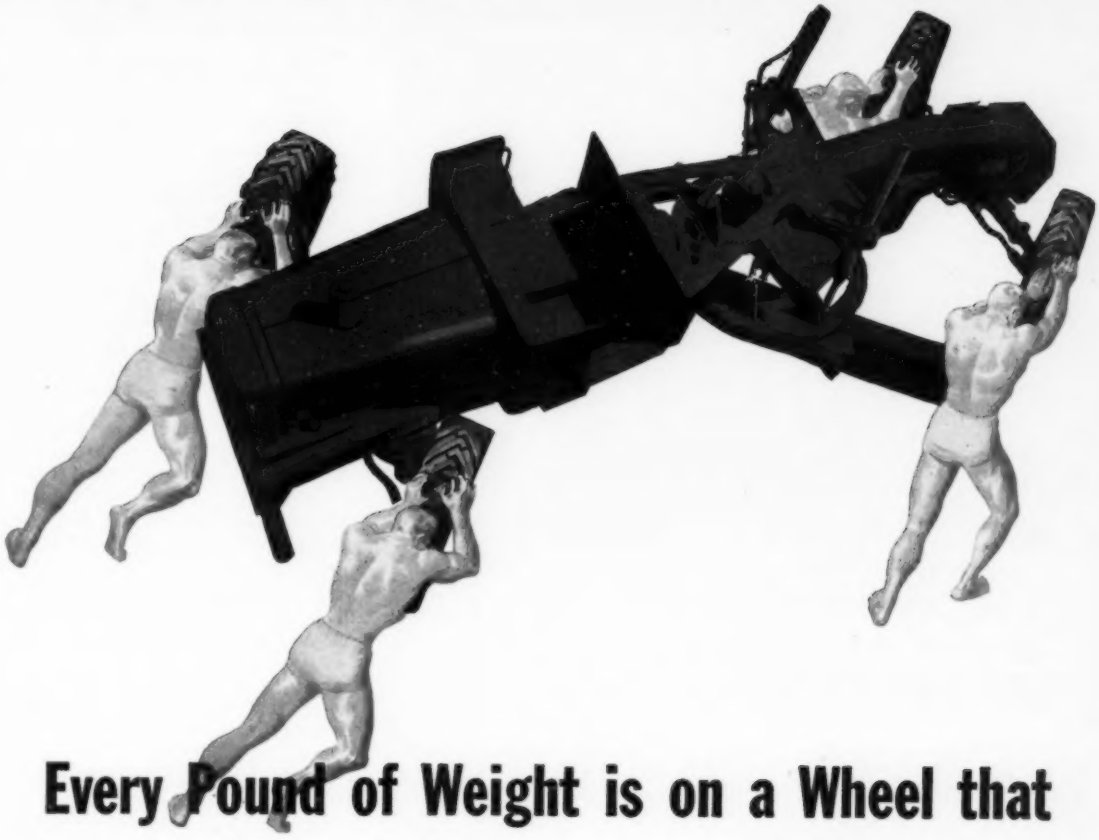
Double, twin beds.....Suite.....

Other.....

Dates of occupancy.....

Time of arrival.....

88-H . . . 99-H . . . MASTER 99



Every Pound of Weight is on a Wheel that

DRIVES and STEERS

That's why these husky graders, with their full hydraulic control, just naturally . . .

Go Places where ordinary graders cannot go.

Do Things ordinary graders cannot do.

Outperform ordinary graders on every job.

AUSTIN-WESTERN COMPANY, AURORA, ILLINOIS, U.S.A.

BUILDERS OF ROAD MACHINERY

Austin Western

SINCE 1859

At West Haven, Conn.

900-bed Veterans Administration hospital, West Haven, Conn. William A. Riley, Architect-Engineer.

VA 475-bed hospital, Wilkes-Barre, Pa. Kelly & Gruzen —Architects.

Wilkes-Barre, Pa. and everywhere, U.S.A.

MERRITT-CHAPMAN & SCOTT builds with full attention to detail

When U. S. Army Engineers award construction contracts for Veterans Administration Hospitals, they demand the highest standard of work at the lowest possible cost. Merritt-Chapman & Scott has received three such competitively bid contracts—proof that we can pass on to clients the benefits of economical operation, while giving full attention to every construction detail.

To each assignment, *large* or *small*, M-C & S brings an organization with extensive knowledge in every construction field. You can be certain the men of Merritt-Chapman & Scott will work closely with you, that your project will be completed as designed, on time.

New brochure presents factual record of M-C & S's ability to solve the most challenging construction problems. Send for your copy today!

MERRITT-CHAPMAN & SCOTT
CORPORATION

Founded in 1860 . . . now in our 90th year

GENERAL OFFICES
17 Battery Place, New York 4, N. Y.

CLEVELAND • BOSTON • NEW LONDON • PASADENA, TEXAS

(*Continued from page 76*)

Gunthlac Wilson, of Scott & Wilson, civil engineers of London, England, has taken into partnership **E. O. Measor** and **Henry Grace.**

W. N. Young, previously assistant to the chief engineer of the Baltimore & Ohio Railroad, has been made chief engineer of McDowell Co., Inc., Cleveland, Ohio.

O. F. Cooley, after 37 years of service, has retired as Los Angeles County, California, road commissioner.

Raymond C. Ridgely recently resigned as superintendent of the Water Department of St. Petersburg, Fla.

James E. Jones has retired as hydrologic engineer of the Los Angeles Department of Water and Power after 14 years of service.

Promotions in the Texas Highway Department involving ASCE members, include **Willis W. Finley** from assistant to engineer of the Fort Worth District, and **James C. Dingwell** from urban engineer of the Houston expressway project to engineer of road design.

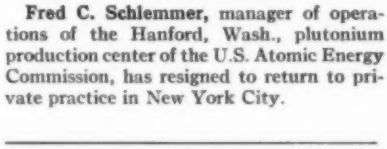
Charles McGonigle was recently elected a director of the Portland Gas & Coke Co., Portland, Ore.

Fox & Mayo, consulting engineers of London, England, announce that **J. D. Lewis** has been named a partner in the organization.

John S. Moore has retired as superintendent of the Minidoka project of the Bureau of Reclamation in southeastern Idaho.

Edmund A. Prentis, partner in the New York firm of Spencer, White & Prentis, was recently presented with the Egleston Medal by the Alumni Association of Columbia University's School of Engineering for distinguished service in engineering.

Fred C. Schlemmer, manager of operations of the Hanford, Wash., plutonium production center of the U.S. Atomic Energy Commission, has resigned to return to private practice in New York City.



STANDING WITH University of Texas faculty members during recent formal initiation ceremonies of Chi Epsilon, honorary engineering fraternity, is ASCE President Ernest E. Howard (third from left), together with (left to right) John A. Focht, professor of highway engineering; J. Neils Thompson, professor of civil engineering; Leland Barclay, assistant professor of civil engineering; S. P. Finch, professor of civil engineering; and Raymond F. Dawson, professor of civil engineering and associate director of Bureau of Engineering Research. Mr. Howard, graduate of class of 1900, is the first alumni member to be elected into local chapter.

New Publications

Soil Sampling. The voluminous report of the Committee on Sampling and Testing of the ASCE Soil Mechanics and Foundations Division, announced in the "Society News" section of this issue, is divided into two main parts: (1) Principles of Exploration and Sampling, and (2) Details of Sampling Equipment and Methods. Supplementing the 520-page descriptive text are about 380 figures, a bibliography of some 600 references arranged to correspond with the 16 chapters, and a subject and name index. Prepared by Dr. M. Juul Hvorslev, Assoc. M. ASCE, after 12 years of research work for the committee, the report was printed by the Waterways Experiment Station—joint sponsor of the project with Harvard University and the Engineering Foundation.

Mississippi River, Maps. Availability of a folio of navigation maps of the Mississippi River from the mouth of the Ohio at Cairo, Ill., to the Gulf of Mexico, showing sketches of river ports, docks and terminals, and other facilities is announced by the Mississippi River Commission. Prepared from river surveys made by the Commission, District offices of the Corps of Engineers, and other federal agencies involved, the present folio constitutes the 17th edition of Mississippi River maps. The scale is approximately 1 in. to 1 mile. The folios, priced at $2 each, may be obtained from the President's Office, Mississippi River Commission, Vicksburg, Miss.

Engineering Research. Descriptions of more than 200 engineering and scientific research projects, conducted during the past year by the Armour Research Foundation of Illinois Institute of Technology make up its 44-page 1949 Annual Report. Sponsored projects include studies of construction materials, such as lath, plaster, and concrete, which promise sturdier and less expensive buildings. A survey of the technical needs of Latin American countries was made for the United Nations Economic Commission for Latin America by the International Division. Founded in 1936 as a scientific research and development organization to serve industry, the Foundation has conducted international research since 1942. The present research volume exceeds $4,000,000. Inquiries concerning the report, which is entitled *Partners in Research*, should be addressed to the Armour Research Foundation of Illinois Institute of Technology, Technology Center, Chicago 16, Ill.

Refresher Texts, California. Engineers wishing to take the California examinations for Registered Civil Engineer may obtain problems and notes from the California P.E. License Examination for the years 1945–1948 by John K. Minasian. Entitled "Fundamentals of Civil Engineering," the 242-page publication sells for $3.50, upon application to the publisher, the School of Applied Engineering, 233 South Broadway, Los Angeles 12, Calif.

(*Continued on page 80*)

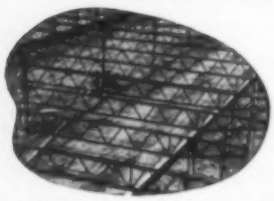
(*Continued from page 79*)

Water Supply, Canada. Results of investigations of surface water supply in Canada made by the Dominion Hydrometric Survey during the climatic years October 1, 1944, to September 30, 1946, in the Provinces of New Brunswick and Nova Scotia, are set forth in Volume 100 of the Water Resources Papers issued by the Canadian Department of Mines and Resources. The report includes a short explanation of the organization and scope of the work and 64 pages of stream-flow and rainfall data. Money orders for the report, which sells for 50 cents, should be made payable to the Receiver General of Canada and sent to the Controller of the Dominion Water and Power Bureau, Department of Mines and Resources, Ottawa, Canada.

Sound Transmission. Research in the field of noise and sound transmission and studies of insulation treatment for buildings, ships, aircraft, and other structures are detailed in a report of the 1948 Summer Symposium of the Acoustics Group, entitled *Noise and Sound Transmission*, recently issued by the Physical Society of London. Engineers from twelve countries attended the 1948 symposium, which made available much valuable information on an international scale. The publication may be obtained from the Acoustical Society of America, 57 East 55th Street, New York 22, N.Y., for $2.75, including postage and handling charges. Orders should be accompanied by remittances made out to the Acoustical Society of America.

(*Continued on page 84*)

FOR STRENGTH... ADAPTABILITY... ECONOMY...



Campbell 66 Motor Terminal
Swan Const. Co.
R. K. Grueninger, Arch.

Bettendorf Super Market
Dickie Const. Co., Wischmeyer and Lorenz, Arch.

USE LACLEDE STEEL JOISTS

- **FASTER CONSTRUCTION** — Light . . easily handled . . prefabricated to speed the job.
- **ADAPTABLE** — They combine efficient structural function with architectural versatility.
- **ECONOMICAL** — They assure more room at less cost. Their high strength plus light weight provide substantial savings in foundation and framework, and utility conduits, pipes and lines are easily threaded through the open webs.

Specify These Laclede Products For Your Construction Needs

Multi-Rib Reinforcing Bars . . Steel Pipe . . Steel Joists & Nailer Joists . . Welded Wire Fabric . . Form & Tie Wire . . Round & Square Spirals . . Conduit . . Corrugated Steel Centering . . Electrical Weld & Gas Weld Tubing.

LACLEDE
LACLEDE STEEL COMPANY
St. Louis, Mo.

Meetings and Conferences

American Congress on Surveying and Mapping. Various aspects of surveying and mapping will be discussed during the tenth anniversary convention of the American Congress on Surveying and Mapping at the Hotel Shoreham, Washington, D.C., June 21–23. Inquiries should be addressed to Murray Y. Poling, U.S. Coast & Geodetic Survey, Room 2814-B, Department of Commerce Building, Washington 25, D.C.

American Institute of Electrical Engineers. A varied program is planned for the summer and Pacific general meeting of the American Institute of Electrical Engineers at the Huntington Hotel, Pasadena, Calif., June 12–16.

American Society for Testing Materials. Testing apparatus and equipment will be displayed during the ninth exhibit and 53rd annual meeting of the American Society for Testing Materials, at Atlantic City, N.J., June 26–30.

American Society of Heating and Ventilating Engineers. The summer convention of the American Society of Heating and Ventilating Engineers will be held at Muskoka Lakes, Ont., Canada, June 20–22.

American Society of Mechanical Engineers. Technical sessions, inspection trips, and social events are planned for the semi-annual meeting of the American Society of Mechanical Engineers at the Statler Hotel, St. Louis, Mo., June 19–23.

Forest Products Research Society. Headquarters for the annual meeting and industry show of the Forest Products Research Society will be Portland, Ore., June 25–29.

New Jersey Builds $220,000,000 Turnpike

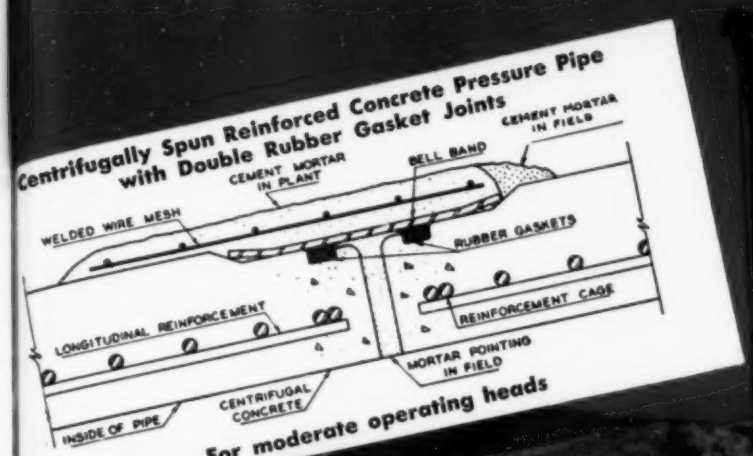
(*Continued from page 40*)

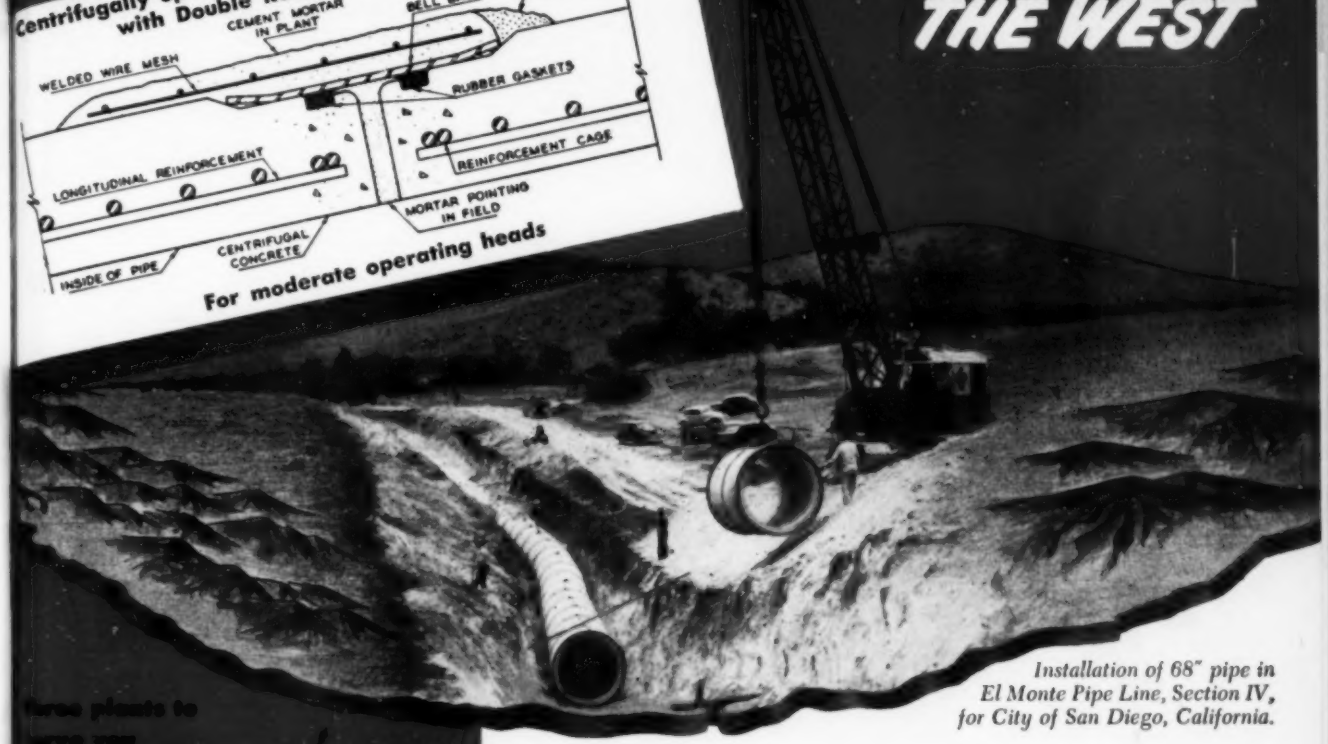
By mid-May the Authority had awarded construction contracts for grading, drainage, bridge foundations, and bridges totaling over $57,000,000. Contracts for the remainder of the grading and all the bridges will be advertised for bids by July 1950.

Engineering design will be continued throughout this year and construction will begin on paving, interchanges, service stations, restaurants and operation and maintenance buildings either before the end of 1950 or early in 1951, so that the turnpike can be opened to traffic late in 1951.

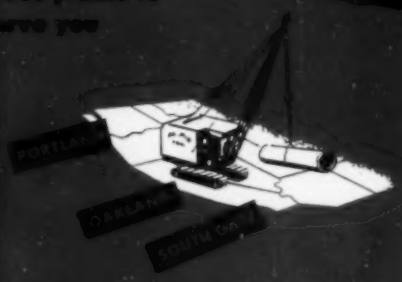
(*This article is based on the author's address before the Metropolitan Section of ASCE.*)

SAVES IN COST OF DELIVERED WATER THROUGHOUT THE WEST





Installation of 68" pipe in El Monte Pipe Line, Section IV, for City of San Diego, California.



Typical Installations

1. Pacific Gas and Electric Co., Kern-Stadium Plant, Bakersfield, California—2,330 Ft. of 48" to 78" Fir operating heads from 60 Ft. to 117 Ft.—1947.
2. Coachella Valley County Water District, Coachella, Calif., U. S. Bur. of Reclamation Project, Units 5, 6 and 7—270,000 Ft. in sizes from 12" thru 72" and for operating heads up to 75 Ft., 1949-1950.
3. Olympia, Washington (McAllister Springs Water Supply Line) 35,000 Ft. of 36" pipe for maximum 150 Ft. operating head—1947.
4. San Diego County Water Authority (San Diego Aqueduct—Sweetwater Extension) 23,500 Ft. of 18"—24" pipe for operating heads up to 130 Ft.—1947.
5. Camp San Luis Obispo, California (U. S. Army) 49,000 Ft. of 24" pipe for heads up to 150 Ft.—1941.
6. City of Whittier, California—6,700 Ft., 21" and 30" pipe for heads of 50 Ft.—1949.

INSTALLATIONS NOW TOTAL NEARLY ONE MILLION FEET

There are five basic reasons why this superior pipe helps reduce the cost of delivered water. They are: *low first cost; ease of installation; sustained maximum performance; freedom from maintenance; permanence.* These and other reasons account for installations throughout the Pacific area, from Canada to Mexico.

This pipe is another example of American's ingenuity and skill in the development of better products for water supply lines. Further information is available upon request.

American
PIPE AND CONSTRUCTION CO.

Concrete Pipe for Main Water Supply Lines, Storm and Sanitary Sewers, Subaqueous Pipe Lines.

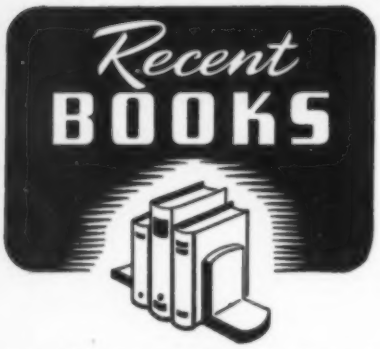
P. O. Box 3428, Terminal Annex • Los Angeles 54, California

QUALITY PIPE LINE PRODUCTS MANUFACTURED AND INSTALLED BY AMERICAN INCLUDE HUME CENTRIFUGAL CONCRETE PRESSURE PIPE, AMERICAN CONCRETE CYLINDER PIPE, PRESTRESSED LOCK JOINT CONCRETE CYLINDER PIPE, LOCK JOINT CONCRETE CLYINDER PIPE, NON-PRESTRESSED.

Main Offices and Plant—4635 Firestone Blvd, South Gate, California

District Sales Offices and Plants

Oakland — San Diego — Portland, Oregon



APPLIED SEDIMENTATION. Edited by P. D. Trask. John Wiley & Sons, New York; Chapman & Hall, London, 1950. 707 pp., illus., diagrs., charts, maps, tables, 9¼ × 6 in., cloth, $5. Containing 35 original articles prepared by specialists, this practical volume describes aspects of mutual interest to the geologist and the engineer. The articles are grouped under the following headings: Basic principles of sedimentation; engineering problems involving strength of sediments; applications of processes of sedimentation; applications involving nature of constituents; economic mineral deposits; petroleum geology problems; and military applications. A list of references accompanies each article.

(The) DESIGN, CONSTRUCTION AND MAINTENANCE OF DOCKS, WHARVES AND PIERS. 3 ed. rev. and enlarged. By F. M. Du-Plat-Taylor. Eyre & Spottiswoode, Publishers Ltd., 15 Bedford Street, Strand, London, W.C.2, England, 1949. 543 pp., illus., diagrs., maps, charts, tables, 11 × 8½ in., cloth, 105s. The new edition of this well-known work incorporates a mass of new data acquired during the past fifteen years. The historical section has been retained, but each one of the practical chapters has been revised and extended to cover modern examples. The organization and administration of ports are fully discussed, and the incidence of air service is considered, including the design of flying boat harbors. Special attention is paid to dock machinery, dredging, concrete work, and excavation methods.

DYNAMICS OF REAL FLUIDS. By E. G. Richardson. Longmans, Green & Co., New York; Edward Arnold & Co., London, 1950. 144 pp., illus., diagrs., charts, tables, 8¼ × 5½ in., cloth, $3.75. This book on hydrodynamics analyzes the following cases: Fluids of small viscosity, flow of compressible fluids, fluids with temperature gradient, a liquid having a free surface, fluids showing anomalous viscosity (suspensions), and elastic liquids. Footnote references to original sources are given.

ÉCHELLES DE CONVERSION DES UNITÉS ANGLO-SAXONNES EN UNITÉS MÉTRIQUES. By J. Bernot. Dunod, Paris, 1950. No pagination, charts, tables, 11¼ × 7½ in., paper, 490 Frs. Logarithmic comparison scales are given for the conversion of units from the metric to the English and American systems and vice versa. Units of length, area, volume, capacity, mass, force, pressure, velocity, acceleration, energy, temperature, heat, and miles per gal are the items dealt with in this way. Skeleton tables of conversion factors for these and related units accompany the scales. Numbered half-scales are provided for the computer's own adaptations.

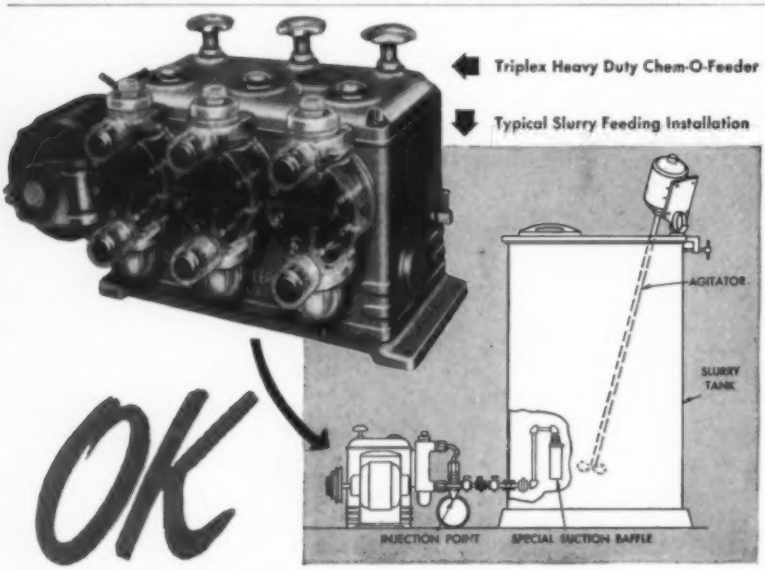
EFFECTIVE TEACHING, A MANUAL FOR ENGINEERING INSTRUCTORS. By F. C. Morris, prepared under the sponsorship of American Society for Engineering Education. McGraw-Hill Book Co., New York, Toronto, London, 1950. 86 pp., illus., diagrs., tables, 9 × 6 in., paper, $.60. A guide for engineering instructors who are interested in the improvement of their teaching methods. It is designed to give first principles of good teaching and to point out some of the more common teaching faults. Definite directions are given for the effective handling of basic activities.

ENGINEERING REPORTS. By L. A. Rose, B. B. Bennett and E. F. Heater. Harper & Brothers, New York, 1950. 341 pp., diagrs., charts, tables, 9½ × 6¼ in., linen, $3. Written for both the engineering student and the practicing engineer, this book deals with the problems connected with the conveying of facts and judgments on a technical level. It stresses the doctrine that effective reports are based on sound craftsmanship. Both written and oral reports of many kinds are considered together with a discussion of the limitations as well as the virtues of each as a medium of communication. Every step in the process of preparing technical reports is developed. Unusual assistance is given with the preparation of illustrations and to non-bibliographic sources of information.

ENGINEERING SURVEYS: ELEMENTARY AND APPLIED. 2 ed. By Harry S. Rubey, George E. Lommel, and Marion W. Todd. Macmillan Co., New York, 1950. 722 pp., illus., diagrs., charts, tables, 5½ × 8 in., cloth, $5. Major changes from 1942 edition are noted in chapters on land surveys, engineering astronomy, and photogrammetry. The book has been revised and brought up to date for use as a text by undergraduate surveying students. Tables of logs and natural functions of angles and trigonometric formulas are included.

HYDROELECTRIC HANDBOOK. 2 ed. By W. P. Creager, M. ASCE, and Joel D. Justin, M. ASCE. John Wiley & Sons, New York; Chapman & Hall, London, 1950. 1,151 pp., illus., diagrs., charts, maps, tables, 9¼ × 6 in., cloth, $12.50. This standard work gives a comprehensive and detailed treatment of the problems involved in hydroelectric-power developments and provides sufficient data for preliminary designs, estimates of costs, and reports. The first of four major sections covers the investigation and planning of a hydroelectric project. The second section discusses and compares the various types of dams and presents the general design methods involved in their construction. Conduits and powerhouses are covered in the third section. In the final section, the mechanical and electrical equipment of a hydro plant and methods for its operation are dealt with. Owing to the extensive developments of the last twenty years, this second edition is considerably enlarged and has been largely rewritten.

INTRODUCTION TO THE ENGINEERING PROFESSION, Concerning Engineering Orientation and Engineering Problems. By J. G. McGuire and H. W. Barlow. Addison-Wesley Press, Cambridge 42, Mass. 207 pp., illus., diagrs., charts, tables, 9¼ × 6¼ in., cloth, $3.50. Presenting information on the principal fields and branches of engineering, together with illustrative problems, this book is of particular value to those who wish vocational guidance. The section on engineering problems presents ideas on the engineering approach to their solution and considers the basic tools of the engineer: The slide rule, logarithms and the principles of mechanics. References to supplementary material are given, including a list of pertinent films and film strips.



OK

For FEEDING SLURRIES *Against Pressure!*

- LIME SLURRY FOR pH CORRECTION
- ACTIVATED CARBON SLURRY FOR TASTE AND ODOR CONTROL
- DIATOMACEOUS EARTH SLURRY FOR FILTRATION
- CALCIUM CARBONATE SLURRY FOR WATER CONDITIONING

%Proportioneers% new Heavy Duty Chem-O-Feeder solves a difficult feeding problem — it's ideal for feeding abrasive slurries against pressure — positively, accurately — without wearing out pump parts. For handling slurries the Chem-O-Feeder has semi-knife edge check valves of stainless steel or silver, with a diaphragm of whipcord-reinforced soft rubber.

The feeding rate can be adjusted with extreme accuracy by merely turning a knob, without stopping the Chem-O-Feeder. A magnifying register glass shows exact reading of stroke length in increments of .001". The plastic See-Thru reagent heads, convenient oil fill, and automatic lubrication reduce maintenance to a minimum. Chem-O-Feeders are available in Simplex, Duplex and Triplex Models to feed up to 8 g.p.h. per unit at pressures to 125 psi. Can be furnished with one or more slurry feeding heads, with other heads feeding different water treating chemicals. Write for information.

% PROPORTIONEERS, INC. %

360 HARRIS AVE. PROVIDENCE 1, R. I.

MACHINE TOOLS FOR ENGINEERS. By C. R. Hine. McGraw-Hill Book Co., New York, Toronto, London, 1950. 355 pp., illus., diagrs., charts, tables, 9¼ × 6 in., cloth, $3.50. Based on courses developed at Rensselaer Polytechnic Institute, this book introduces the student to the fundamentals of machine tools and production processes. It gives a descriptive and analytical treatment of all types of machine tools, how they are used, what they can do, and what their limitations are. Some of the ways in which machine tools affect design of any product are discussed. The important machining processes are also covered.

MATERIALS HANDLING MANUAL (III). Editors, M. M. Williamson and G. W. Williamson. Paul Elek (Publishers) Ltd., Diamond House, 38 Hatton Garden, London, E.C.1, England, 1949. 364 pp., illus., diagrs., tables, 8¾ × 5½ in., cloth, 30*s*. This volume, as its predecessors, deals with aspects of handling applicable to all industries, with the exception that this edition is restricted to the handling of bulk materials, omitting package handling. All its sections have been brought up to date, and several new sections have been added, including a detailed treatment of underground materials handling machinery. Both continuous movement (conveyors, elevators, pneumatic systems, etc.) and intermittent movement (earth-moving equipment, cranes, etc.) are covered.

Books in the Engineering Societies Library may be borrowed by mail by ASCE members for a small handling charge. The Library also prepares bibliographies, maintains research and photostat services, and can provide microfilm copies of any item in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 29 West 39th Street, New York 18, N. Y.

MATHEMATICS DICTIONARY. Rev. and enlarged ed. Edited by Glenn James and Robert C. James. D. Van Nostrand Co., Inc., New York, 1949. 432 pp., illus., 6½ × 9½ in., cloth, $7.50. An encyclopedic dictionary of terms, symbols, and concepts used in pure and applied mathematics for reference by students, practicing engineers, and others. Coverage begins with arithmetic and extends through calculus, including many tables and formulas.

MECHANICAL PROPERTIES OF WOOD. By F. F. Wangaard. John Wiley & Sons, New York; Chapman & Hall, Ltd., London, 1950. 377 pp., illus., diagrs., charts, tables, 8½ × 5½ in., cloth, $6. A thoroughly revised version of G. A Garratt's 1931 book of the same title, this volume provides information on the properties of more than 150 American woods as well as tables of basic-stress and working-stress values for structural species. The four parts treat: The basic mechanical properties of clear wood; factors affecting the mechanical properties; working stresses for structural lumber; and timber testing. References appear at the end of each section. The appendix contains a sample plan for testing small clear specimens of wood.

PLANE SURVEYING. By Frank R. Theroux and Lisle A. Smith. Pitman Publishing Corp., New York, 1950. 333 pp., illus., diagrs., charts, tables, 5 × 7½ in., cloth, $3.50. Written as a concise text for work covered in elementary courses. Chapters on measurement of distances, elevations, angles, stadia surveying, curves, mapping, earthwork, simple astronomical observations, and adjustment of instruments are given. Six-place log tables of numbers and functions of angles and five-place tables of natural functions complete this pocket-size text.

PUBLIC HEALTH AND MUNICIPAL ENGINEERING CONGRESS AND EXHIBITION, 7TH, 1948, REPORT. Congress Organizing Council, 84 Eccleston Square, London, S.W.1, England, 1949. 684 pp., illus., diagrs., charts, maps, tables, 9¾ × 7¼ in., stiff cardboard, 10*s*.6*d*. to general public free to delegates. This volume contains papers and discussions as well as a list of the exhibitors and delegates present at the Congress. The topics covered include the mechanization of municipal and highway engineering works, treatment of industrial effluents, mechanical appliances in parks, water supply, district heating, sewage treatment, and health measures.

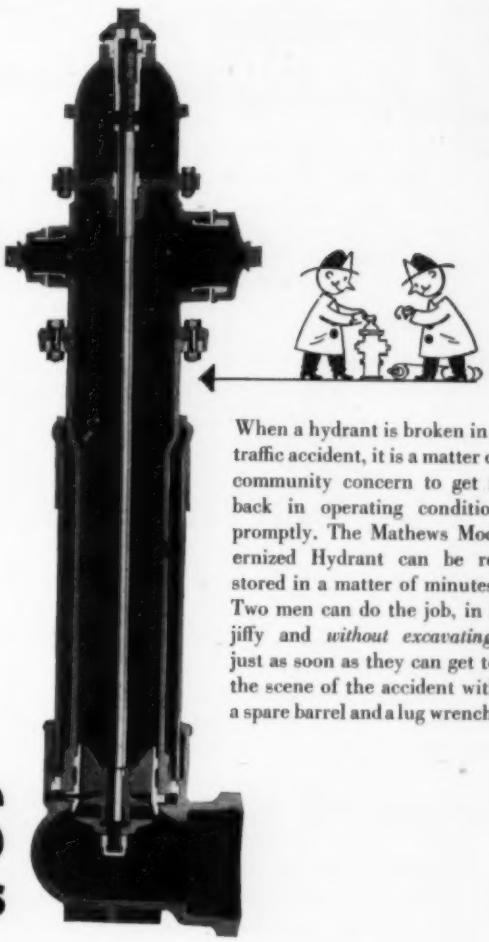
RAILROADS OF TODAY. By S. K. Farrington, Jr. Coward-McCann, Inc., New York, 1949. 306 pp., illus., tables, 8¾ × 5½ in., cloth, $6. New trains, operations, and mechanical developments are described. Among the railroads treated are six not included in the author's previous books on railroading. Centralized traffic control, new signal devices, new retarder hump yards, and track inspection cars are given special attention, and separate chapters are devoted to brake development, bearings for high-speed freight service, and switch and signal installations. There is an unusually detailed index, and there are 72 pages of photographs of new trains in current operation.

SCHOLARSHIPS, FELLOWSHIPS AND LOANS. By S. N. Feingold. Bellman Publishing Co., 83 Newbury St., Boston 16, Mass., 1949. 254 pp., 9¾ × 6¾ in., cloth, $6. The information given in this reference book is listed alphabetically by administering agency with address, name of grant, qualifications, funds available, special fields of interest and information, and where to apply for information. In an introductory section the author discusses career planning and aids. The latter part of the book contains a bibliography, a subject index, and indexes of the administering agencies and names of grants.

THE STORY OF BIG CREEK. By David H. Redinger, Angelus Press, Los Angeles, 1949. 182 pp., illus., diagrs., 6½×9½ in., cloth, $2.50 plus postage. Biography of the Big Creek-San Joaquin power project in the high Sierras of California. From earliest conception by John Eastwood, through the building of a railroad completed on the project in 157 days, unprecedented road building, tunnel driving, dam construction, and snowed-in construction camps at high altitudes, this is a story of hard-working, enterprising Americans willing to underwrite their risk in developing hydroelectric power.

WELDING HANDBOOK. 3 ed. American Welding Society, compiler and publisher, 33 West 39th St., New York 18, N.Y., 1950. 1,651 pp., illus., diagrs., charts, tables, 9¼ × 6 in., cloth, $12 in United States and Canada, $13 elsewhere. This standard handbook contains 65 chapters covering the more than 30 welding and cutting processes used by industry today, the welding of ferrous and nonferrous metals and alloys, and the application of welding in different industries. Also included are individual chapters on cost estimating, welding metallurgy, physics of welding, a dictionary of welding terms, general engineering tables, welding symbols, and inspection methods. A bibliography at the end of each chapter lists important codes, standards, books, and technical articles. A detailed 69-page index provides ready access to the material.

SPEED OF REPLACEMENT MEANS SAFETY FOR THE COMMUNITY



When a hydrant is broken in a traffic accident, it is a matter of community concern to get it back in operating condition promptly. The Mathews Modernized Hydrant can be restored in a matter of minutes! Two men can do the job, in a jiffy and *without excavating*, just as soon as they can get to the scene of the accident with a spare barrel and a lug wrench.

MATHEWS HYDRANTS

Made by R. D. Wood Company

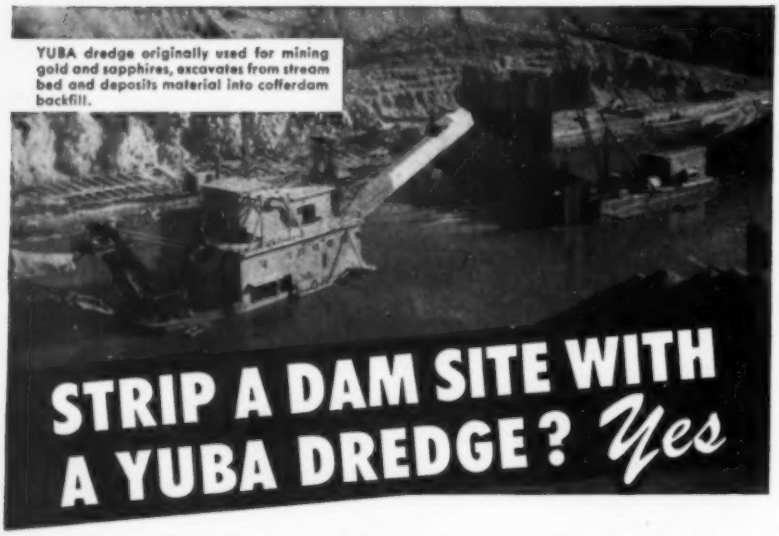
Public Ledger Building, Independence Square

Philadelphia 5, Pa.

Manufacturers of "Sand-Spun" Pipe (centrifugally cast in sand molds) and R. D. Wood Gate Valves.

THE FIREMAN'S FRIEND

Mathews Modernized Hydrants Set the Pace: Easily maintained because simple in construction • All working parts contained in the replaceable barrel • Stuffing box cast integral with nozzle section • Head can be turned 360° • Replaceable head • Nozzle sections easily changed • Nozzle levels raised or lowered without excavating • Protection case of "Sand-Spun" cast iron for extra strength, toughness, elasticity • Operating thread only part to be lubricated • A modern barrel makes an old Mathews good as new


YUBA dredge originally used for mining gold and sapphires, excavates from stream bed and deposits material into cofferdam backfill.

STRIP A DAM SITE WITH A YUBA DREDGE? *Yes*

At Canyon Ferry Dam on the Missouri River near Helena, Montana, Canyon Constructors save months of time by using a YUBA dredge to handle dam site excavation and cofferdam backfilling in one operation instead of separately.

Dredge stacker also discharges to haul road directly into trucks or for rehandling by shovel and trucks.

DREDGE REMOVES BOULDERS

Sub-contractor Perry & Schroeder Mining Co. moved in a Yuba placer dredge with 6 cu. ft. buckets and 48 ft. digging depth, dug out boulders so sheet piling could be driven for cofferdams. Then the dredge began excavating and backfilling the cofferdams; stripped 250,000 cu. yds. of underwater overburden down to bedrock by the time the diversion flume was ready.

AVERAGES 320 CU. YDS. PER HOUR

Altogether the dredge will handle about 1,000,000 cu. yds. of material, including production of aggregate from underwater deposits. It works three 8-hour shifts daily, averages 320 cu. yds. hourly; has a reach from bucket line tip to stacker end of 250 feet and can discharge material 40 feet above water line.

Consult YUBA—No matter what your bucket ladder dredging problem—digging deep ground, clay, boulders, or bedrock; constructing levees, cofferdams or canals; producing aggregate or changing stream channels—YUBA can help you. Write or wire us TODAY. No obligation.

YUBA MANUFACTURING CO.

Room 716, 351 California St., San Francisco 4, California, U. S. A.

AGENTS { SIME, DARBY & CO., LTD. · SINGAPORE, KUALA LUMPUR, PENANG.
SHAW DARBY & CO., LTD., 14 & 19 LEADENHALL ST., LONDON, E. C. 3.

CABLES: YUBAMAN, SAN FRANCISCO · SHAWDARBCO, LONDON

Positions Announced

Civil Service Commission, Detroit. The Detroit Civil Service Commission has announced that examinations have been extended indefinitely in the following fields: Junior City Planner, $3,298–$3,749 per annum; Intermediate City Planner, $4,067–$4,544 per annum; and Senior City Planner, $4,939–$6,134 per annum. Residence requirements for application have been waived. For further information write to Ralph Mueller, Head Personnel Examiner, Examination Division, City of Detroit, Civil Service Commission Office, 735 Randolph Street, Detroit 26, Mich.

New Publications

(*Continued from page 80*)

Soil Investigations, Charleston. Reprints of a brief report on "Marl Formation at Charleston, S.C., and Its Suitability for Underground Installation," prepared by the Charleston Development Board, are available upon request to the Board at 152 Market Street, Charleston, S.C. Arthur M. Field, M. ASCE, is chief engineer of the Board.

Water Resources. The water power resources of Canada, currently developed and potentially available, are summarized in Bulletin No. 2271, recently issued by the Water Resources Division of the Canadian Department of Resources and Development. The total turbine installation at the end of 1949 is given as 11,613,333 hp, indicating that only 21 percent of available resources has been developed. Copies of the review may be obtained without charge from the Chief, Water Resources Division, Department of Resources and Development, Ottawa, Canada.

Highway Research. Issuance of an index to all the principal publications of the Highway Research Board, from the time of its organization in 1921 through 1949, is announced by the Board. Papers and reports given at the first 28 annual meetings of the Board, as well as numerous publications not presented at annual meetings, are listed in the 147-page index, which includes both subject and author classifications. For information about publications available for sale or free distribution address the Highway Research Board at 2101 Constitution Avenue, N.W., Washington, D.C.

TOTAL MEMBERSHIP AS OF MAY 9, 1950

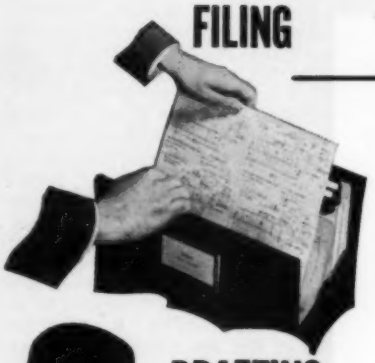
Members	7,580
Associate Members	9,756
Honorary Members	39
Junior Members	11,222
Affiliates	73
Fellows	1
Total	28,671
(May 9, 1949	25,714)

At the Crompton & Knowles Looms Works
WORCESTER, MASS.

3 engineering department routines simplified

with Kodagraph Autopositive Paper

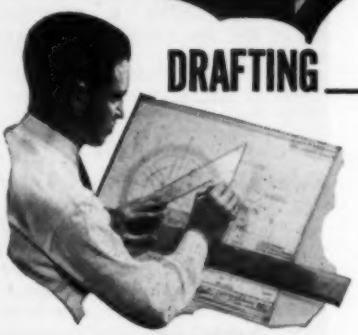
FILING



A low-cost, photographic intermediate paper that produced positive copies directly was "big news" for Crompton & Knowles, world's largest manufacturer of specialty looms. To begin with, it meant that they could reorganize their filing system much faster and much more economically than had been estimated. *Here was the problem:* they had some 200,000 detail drawings —4 to 8 on each sheet of paper. Many of these were not in sequence, which slowed reference; and, when blueprints of only one part were needed, it meant a waste of paper . . . besides taking the attached drawings out of the files. *Solution:* the design sheets were reproduced on Kodagraph Autopositive Paper; then the prints were cut and filed correctly in the "master" file.

★ ★ ★

DRAFTING



Crompton & Knowles has adopted the rule: *"A Kodagraph Autopositive intermediate of every drawing."* And this is paying off today in lower re-drafting costs. *Before,* the original detail drawings (described above) and scale drawings were used as the blueprint "masters" . . . were exposed to machine wear-and-tear, constant handling. When they no longer produced legible blueprints, they had to be redrawn. *Now* the valuable originals are kept safe in the files—available for reference and revisions only. The "Autopositives" do the "heavy work" . . . whenever needed.

★ ★ ★

PRINT PRODUCTION

Using Kodagraph Autopositive intermediates, Crompton & Knowles turns out sharper, cleaner blueprints—at uniform, practical machine speeds.

That's because these new intermediates have an evenly translucent, high-quality paper base . . . and dense photographic black lines which will not smudge or lose opacity even after hundreds of trips through the machine.

How "Autopositives" are produced: Crompton & Knowles uses its blueprint machine for exposure; standard photographic solutions for processing. In this manner it gets positive copies directly —without a negative step . . . without darkroom handling.

Kodagraph Autopositive Paper

"THE BIG NEW PLUS" in engineering drawing reproduction

- **It enables you, or your local blueprinter, to produce positive photographic intermediates at a new low cost.**
- **It preserves valuable originals . . . cuts redrafting costs.**
- **It restores old, soiled drawings . . . gives you cleaner, sharper prints.**
- **It gives you photo-lasting file copies.**

A new illustrated booklet,* "Modern Drawing and Document Reproduction," gives all the facts on this revolutionary photographic intermediate. *It's free. Just mail the coupon.

Please mail a copy of "Modern Drawing and Document Reproduction"—your new free booklet on Kodagraph Autopositive Paper.

EASTMAN KODAK COMPANY
Industrial Photographic Division
Rochester 4, N. Y.

93

Name_____

Position_____

Company_____

Street_____

City_____ State_____

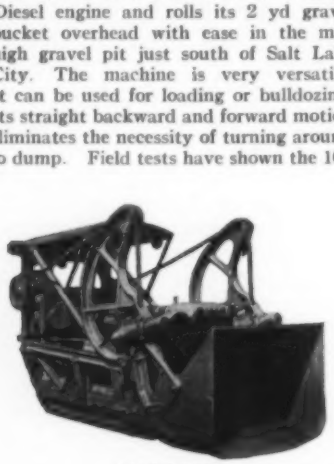
Kodak
TRADE-MARK

EQUIPMENT, MATERIALS *and Methods*

NEW DEVELOPMENTS OF INTEREST, AS REPORTED BY MANUFACTURERS

RockerShovel

THE ROCKERSHOVEL MADE its first public demonstration in March. Loading wet sand and gravel at the rate of 8 yd per min, the 104 filled the 6 ton Dumptor in about 40 sec. The 104 has a 48 hp Diesel engine and rolls its 2 yd gravel bucket overhead with ease in the mile high gravel pit just south of Salt Lake City. The machine is very versatile. It can be used for loading or bulldozing. Its straight backward and forward motion eliminates the necessity of turning around to dump. Field tests have shown the 104



Model 104

to be at least twice as fast as much larger conventional excavators that have many times the power. The RockerShovel 104 is designed to dig and load blocky rock and abrasive ores in underground or surface operation. It is constructed of abrasion-resistant alloy-steel materials throughout. For heavy-duty rock loading, the 104 is equipped with a $1^1/_4$ yd bucket. The 104 is powered by either Diesel engine or electric motor. **The Eimco Corp., 634–666 S. Fourth West St., Salt Lake City 8, Utah.**

Masonry Drills

"LIVE-SPIRAL MASONRY DRILLS are easy to use in any portable rotary drill, drill press, hand brace, or rotary-impact drill. These drills are tipped with a special, ultra-hard metal, Carboloy cemented carbide, the hardest metal made by man. They are designed for all-purpose continuous drilling in most ordinary types of non-metallic construction materials. If you've ever drilled a hole in cement or concrete, tile or plaster, etc., you'll appreciate what it means to be able to drill holes so much faster—without stopping—to the full depth of the shank; with lighter pressure; without stalling; without dust "explosions." For further information write **Carboloy Company, Inc., Detroit 32, Mich.**

Diesel Engines

INCREASED-HORSEPOWER, improved-performance diesel power units and automotive engines of the four-cylinder International "9" series, are now available in new UD-9A models. Engineering design changes which accomplish greater power output, smoother operation and longer service life of parts, have been made in both the UD-9A automotive engine for motor graders and other self-propelled machines and the UD-9A power unit for a wide variety of stationary installations in many industries. New features of the basic "9" engine include: redesigned precombustion chamber and piston; the "A" series I.H. fuel injection pump; simplified injection nozzles; counterbalanced crankshaft and new connecting rods. As a power unit equipped with air cleaner, radiator, fan and clutch, the UD-9A delivers 62.5 hp at 1600 rpm under intermittent load. The UD-9A automotive engine operates at governed 1800 rpm, delivering 70 hp at that speed. Both power unit and automotive engine have the exclusive inbuilt International gasoline conversion all-weather starting system; full-pressure lubrication of moving parts, and other time-proved features of previous models. Complete specifications and other information are available from **International Harvester Co., Consumer Relations Dept., 180 N. Michigan Ave., Chicago 1, Ill.**

Ripper for Tractor Shovels

THE SHAW HEAVY-DUTY RIPPER, is especially designed for quick attachment to Allis-Chalmers HD 5 G tracto-shovels and can be attached to the HD 5 tractor equipped with hydraulic controlled bulldozer with front mounted pump. The ripper works to a maximum depth of 15". It has been extensively field tested under tough, adverse conditions and does an excellent job of ripping and loosening decomposed granite, hard packed earth and adobe and works most satisfactorily in tearing up old asphalt and macadam roads and works with equal facility on many other materials. The ripper is a complete unit with standard equipment composed of ripper frame, 4 shanks and ripper points, hydraulic cylinder, all necessary hose and fittings, and attachment bolts. The frame is built to take up to 7 ripper shanks with shank holes spaced on 12" centers for any desired combination depending upon nature of the work. Ripper shanks are $1^3/_4$" thick, 3" wide and 24" long. Points can be removed from shanks for resharpening or replacement when worn. New literature and complete information can be secured from local Allis-Chalmers dealers or **Shaw Sales & Service Co., 5100 Anaheim Telegraph Rd., Los Angeles 22, Calif.**

Emulsified Asphalt Plants

A SERIES OF COMPLETELY portable units for making asphalt emulsions "on the job," or at central stationary installations have been manufactured. Production capacities of 500, 1000, 2000, 3000, 4000 and 6000 U.S. gal per hr of emulsion are available; Complete plants are made in single units (all on 1 chassis or trailer) in capacities up to 2000 gph, and in multiple units for 3000 to 6000 gph. Technical advice and consultation on asphalt paving specifications and design, development of asphalt processes for specific problems and laboratory analysis of aggregates and asphalts used in making emulsions is supplied. Literature can be secured by writing the manufacturer. **K. E. McConnaughay, Rm. 209, Painters & Decorators Bldg., Lafayette, Ind.**

Power Buggy

AN ENTIRELY NEW 1950 model of the unique, versatile Whiteman power buggy is announced. For use in construction, manufacturing, maintenance. . .wherever materials of all kinds must be moved quickly and economically, this piece of equipment offers many improvements over previous models. The dumping operation is made faster and easier by a new curved rack and pinion mechanism which improves leverage and gives the operator full control of the dump, and return of the bucket when partial dumping is required.

1950 Model

Speed of the power buggy has been increased from 12 to 16 mph. Carrying capacity has been enlarged from 12 to 13 cu ft. Maximum load is 2,000 lbs. A lower center of gravity, wider tread and shorter wheelbase, gives better distribution of weight and improves maneuverability. The new model can be used on light scaffolds or runways. The buggy is powered by a 7.5 hp, 4 cycle, air-cooled engine. It has an automatic clutch and speed changer, power to pull a load up 25% inclines and ability to turn in its own length. **Whiteman Mfg. Co., 3249 Casitas Ave., Los Angeles 39, Calif.**

Equipment, Materials & Methods (Continued)

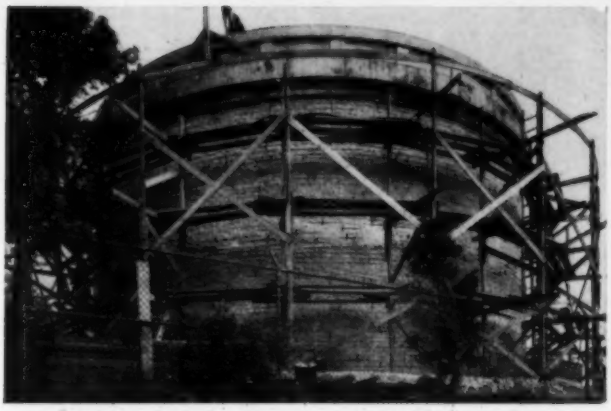
Earth Boring Tool

FASTER AND LOWER COAT SERVICE pipe installations are expected from a newly developed Hydrauger, earth boring tool. Unique features of this fast earth boring machine are a full length sled mount and an air driven cable winch which pulls the entire machine along as it advances the boring bit forward into the ground. Up to 70 ft of drill stem can be laid out ahead of the machine and pulled into the earth formation by means of the winch and cable. Rapid boring of both 2 and $2^1/_2$ in. holes is claimed by means of rock, hardpan or clay type bits. Like other hydrauger earth boring tools so widely used during the last twenty years, both air and water are used for operating the machine. This new model is the first however, to have a built-in pressure water pump for 110 psi non-clogging water circulation. The machine can work successfully in positions too cramped for any other type of pipe installing machine. The "Scooter Model" Hydrauger uses $1^3/_{16}$ in. hollow boring bars in sectional lengths up to 10 ft. Drill stem assembly is withdrawn from the bore under air winch power and the service pipe can be drawn into the hole as the stem is withdrawn. Further details can be secured from **Hydrauger Corp., Ltd., 681 Market St., San Francisco, Calif.**

Concrete Cutter

THE DI-MET STANDARD model concrete cutter, which has been developed to sell at a considerably lower cost than the heavy-duty Di-Met Machine, yet handles practically all ordinary concrete cutting requirements has been announced. The Di-Met standard model uses a 12" maximum diamond wheel size on either the right or left end of the spindle, cutting to a $3^1/_2$" depth. Spindle is mounted in ball bearings. The diamond wheel can be lowered readily to proper cutting depth by means of a manually operated worm and gear, or when cutting is not required, the worm gear lifts the diamond wheel completely clear of the work. Two Coolant provisions have been made. A 15 gal tank supplies water to the blade when other sources are unavailable. Pressurized water may be supplied from mains or tank trucks through a hose to an independent water connection. Valves are provided which shut off the 15 gal tank supply when water is furnished through a hose. Jets force the water stream against blade sides to insure proper cleansing and cooling. Balance of the complete unit is such that it can be readily pivoted on the rear wheels, turning in its own length. The cutter is powered with a 7.5 hp Wisconsin air cooled gasoline engine which is almost instantly removable. **Felker Mfg. Co., Torrance, Calif.**

(*Continued on page 90*)



CEMENT GUN COMPANY PRE-STRESSES AND RESTORES *EXISTING* WATER TANK

The progress picture above shows a stage of our repair work on a concrete water tank in New England. This tank was completely lined with reinforced "GUNITE" to stop seepage which had caused serious disintegration to the exterior of the tank. The entire outside of the tank was subsequently chipped and existing hoop rods exposed.

To strengthen the tank, wedges were driven behind the rods to take up the slack. This placed the rods in tension and the concrete in direct compression. Wire mesh was then attached to the reinforcing rods and the entire tank treated with two inch mesh reinforced "GUNITE."

The use of "GUNITE" for repair and construction of reservoirs, bridges, buildings, etc., is illustrated and described in Bulletin B 2400. We will gladly send a copy at your request. On your letterhead please.

CEMENT GUN COMPANY
"GUNITE" CONTRACTORS
GENERAL OFFICES—ALLENTOWN, PENNA., U.S.A.
MANUFACTURERS OF THE CEMENT GUN

FOUNDATIONS
PRETEST UNDERPINNING
CONCRETE-STEEL PILES
MASS CONCRETE CONSTRUCTION
HEAVY SHORING
DRILLED-IN CAISSONS

Send for catalogs descriptive of the latest foundation types and methods.

SPENCER, WHITE & PRENTIS, INC.
10 EAST 40th ST. NEW YORK 16, N. Y.
602 HAMMOND BLDG., DETROIT 76, MICH.

SHOCK STRENGTH

Without shock strength—or, for that matter—without all of the strength factors listed opposite—no pipe laid 100 years ago in *city streets* would be in service today. But, in spite of the evolution of traffic from horse-drawn vehicles to heavy trucks and buses—and today's vast complexity of subway and underground utility services—cast iron gas and water mains, laid over a century ago, are serving in the streets of more than 30 cities in the United States and Canada. Such service records prove that cast iron pipe combines all the strength factors of long life with ample margins of safety. No pipe that is provably deficient in any of these strength factors should ever be laid in city streets. Cast Iron Pipe Research Association, Thos. F. Wolfe, Engineer, 122 So. Michigan Ave., Chicago 3.

CAST IRON PIPE

Strength factors of Long Life!

No pipe that is provably deficient in any of these strength factors should ever be laid in city streets

SHOCK STRENGTH

The toughness of cast iron pipe which enables it to withstand impact and traffic shocks, as well as the hazards in handling, is demonstrated by the Impact Test. While under hydrostatic pressure and the heavy blows from a 50 pound hammer, standard 6-inch cast iron pipe does not crack until the hammer is dropped 6 times on *the same spot* from progressively increased heights of 6 inches.

CRUSHING STRENGTH

The ability of cast iron pipe to withstand external loads imposed by heavy fill and unusual traffic loads is proved by the Ring Compression Test. Standard 6-inch cast iron pipe withstands a crushing weight of more than 14,000 lbs. per foot.

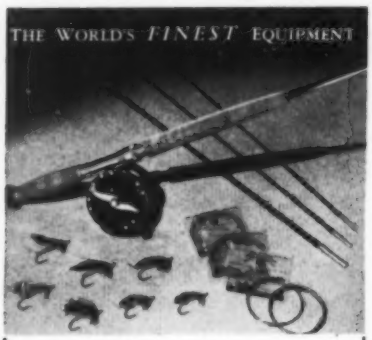
BEAM STRENGTH

When cast iron pipe is subjected to beam stress caused by soil settlement, or disturbance of soil by other utilities, or resting on an obstruction, tests prove that standard 6-inch cast iron pipe in 10-foot span sustains a load of 15,000 lbs.

BURSTING STRENGTH

In full length bursting tests standard 6-inch cast iron pipe withstands more than 2500 lbs. per square inch internal hydrostatic pressure, which proves ample ability to resist water-hammer or unusual working pressures.

SERVES FOR CENTURIES



FOR THE WORLD'S
MOST *PARTICULAR* SPORTSMEN

For those precious hours of relaxation, professional men want the FINEST in fishing tackle. And the Charles F. Orvis Co. offers the most complete line of FINE fishing tackle in the country—from custom-built Orvis Impregnated Rods to custom-tied flies.

No matter what kind of fishing trip you are planning, Orvis equipment—perfectly balanced, and built to your own personal requirements—will provide the ultimate in fishing pleasure.

Send for our FREE 1950 catalogue today

CHARLES F. ORVIS CO.
122 Union St., Manchester, Vermont

MAKERS OF *Orvis Impregnated*
SPLIT BAMBOO FISHING RODS
TROUT-BASS-SALMON-GRILSE-STEELHEAD
SALT WATER-SPINNING-CASTING

For KNOW-HOW • ENGINEERING
SUPERVISION • EQUIPMENT

Stang
WELLPOINT
SYSTEM

Keeps jobs Dry!

The Stang System has proved its efficiency and economy on both large and small jobs all over the United States. Stang engineering and supervision in planning, installation and operation insures a DRY JOB at all times.

JOHN W. STANG
CORPORATION
2 Broadway New York 4, N. Y.
2123 S. 56th St. Omaha, Nebr.
8221 Atlantic Av. P.O. Box 631, Bell, Cal.

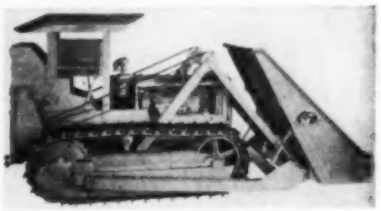
Equipment, Materials & Methods (Continued)

Tournarocker

A REAR DUMP HAULING UNIT, the E-9 Tournarocker, has been announced. Designed for loading by shovel, dragline, or backhoe, the E-9 is powered by the D Roadster Tournapull prime mover with the GM 4–71 engine and is especially suited for construction work. It has a 9 ton or 10 cu yd heaped capacity. Its big 11′ by 7′ top opening and low body—only 7′ high for rear loading—permits easy spotting and loading. The load is carried down between the wheels, giving a low center of gravity for greater stability. The Tournarocker dumps material behind its rear tires by raising the rocker body with a cable and sheave arrangement which is actuated by a Tournatorque electric motor. This arrangement enables the Tournarocker to dump over the edge of fills. Forward speeds range from 2.77 to 25.27 mph; reverse speed 2.76 mph. The D Roadster Tournapull which powers the Tournarocker features positive electric power steer, sliding gear transmission and patented torque-proportioning differential. **R. G. Le Tourneau, Inc., Peoria, Ill.**

Overshot Loader

RECENT ADDITION to a line of overshot loaders for tractor mounting is the Austin Model 4-C. The loader is readily attached to utility size tractors, including the Caterpillar D-4, Allis Chalmers HD-5, and International TD-9. The loader has



Model 4C

a rated capacity of 1 cu yd and a 20 sec loading cycle. It will handle back-run material at a rate of 125 yd per hr on a 50 min hr with no increase in fuel consumption over normal dozing operations. The overshot action, which eliminates swinging and blocking, is powered by a Caterpillar Model 24 cable control unit driving a single cable through a wrap-around series of sheaves. The result is even tension at both sides, maximum power at the start of the loading cycle, and maximum speed for the balance of the cycle. The Austin Model 4-C loader is made in two heights, for surface operation and for underground mining, respectively. The standard machine for surface operation has an overall height of 15′ 3″ with bucket raised, and a dumping clearance of 8′. For underground mining it has an overall height of 12′, bucket raised, and a dumping clearance of 6′. Both units have adequate clearance for highway transportation and low underpasses. Literature is available. **John Austin, Inc., Denver, Colo.**

CONTRACTORS
for

DIAMOND ROCK
CORE BORINGS

•

DRY SAMPLE
SOIL BORINGS

•

FOUNDATION TESTING

•

PRESSURE GROUTING

•

WRITE FOR ESTIMATES

SPRAGUE & HENWOOD Inc.
Dept. CE
SCRANTON, PA.
Pittsburgh • NewYork • Philadelphia

NOW AVAILABLE
GLOSSARY:
WATER AND SEWAGE
CONTROL ENGINEERING

A Wealth of Engineering Terms 276 pages with 4,200 Definitions and Cross References

Price $2.00
(50% discount to members for first copy)
A limited number of cloth bound copies available at only $1.00 extra per copy.

SEND AT ONCE USING THE COUPON BELOW!

American Society of Civil Engineers
33 West 39th Street, New York 18, N. Y.

Please forward "GLOSSARY: Water and Sewage Control Engineering," as indicated.

☐ .... copies paper covered at $2.00
☐ one copy only " " " 1.00 (To Members)
☐ .... copies cloth bound at $3.00
☐ one copy only " " " 2.00 (To Members)

Payment is enclosed herewith

Name .....
Grade Membership .....
Address .....
City .....

Equipment, Materials & Methods (Continued)

Soil Sampling Kit

A COMPACT AND VERSATILE, hand-operated soil sampling kit enclosed in a handy steel case which can be carried in any automobile is used for obtaining accurate, dependable subsurface information. The twelve soil and earth sampling tools included in this kit can be used to obtain accurate samples to depths up to 25 ft in practically all soil and earth formations. The kit can be used for: testing clay deposits; foundation test borings; sampling gold bearing sands; exploring sand and gravel deposits; subgrade testing prior to highway and airfield runway construction; checking base materials for soil cement stabilization and many other uses. Standard tools furnished with the kit include a tough, heat-treated probe for simple exploration, a chopping bit and an Iwan post hole auger for starting holes, a closed auger, a Jamaica auger and a ship auger for sampling sticky, cohesive material such as loam, clay and kaolin, a split tube sampler and a Chicago thin-wall tube for obtaining undisturbed samples, and a dozen sample jars in addition to the necessary drill rods and fittings. When necessary, special devices can be furnished to cope with unusual requirements. For information write to the **Acker Drill Co., Inc. 725 W. Lackawanna Ave., Scranton, Pa.**

Portable Plant

A NEW ADDITION to Universal's Twin-Dual series of portable plants has recently been designed. The TwinDual "Gravel-King" features three stages of crushing with scalping screen feed. A pre-screening operation sizes and removes natural sand and gravel. Large boulders usually rejected in ordinary gravel operations are scalped to a large opening primary. Material requiring secondary reduction is by-passed to the TwinDual roll crusher for the second and third stages of crushing. 100% chips can be produced, or finished material from the scalping screen blended with crushed material from the plant. The plant is also designed for conversion to quarry operation in the field. An apron feeder is interchangeable with the scalping screen for quarry rock. The TwinDual "Gravel-King" is made in two sizes—the Junior with 1824 roller bearing jaw crusher, 24" TwinDual roll Secondary, 3′ × 8′ 2½-deck gyrating screen, 3′ × 6′ 2-deck gyrating scalping screen and swivel feed conveyor. The Senior has 2036 roller bearing jaw crusher, 30" TwinDual Roll Secondary, 4′ × 10′ 2½-deck gyrating screen, 4′ × 10′ 2-deck gyrating scalping screen and swivel feed conveyor Complete plant operates from one power unit. Complete description is available in Bulletin No. U-501. **Universal Engineering Corp., Cedar Rapids, Iowa.**

If you do big construction you need this
LOW-COST
PRECISION TRANSIT

Price Only $400 Complete with Tripod. With "A" Standard and Compass — $425.00 F.O.B. Factory

The David White Western Precise Preliminary Transit gives you wide Versatility for Engineering and Surveying

Why do you need this instrument? Because, no other instrument gives you the precision, the easy, fast working facilities for a variety of engineering and survey work *at so low a cost.*

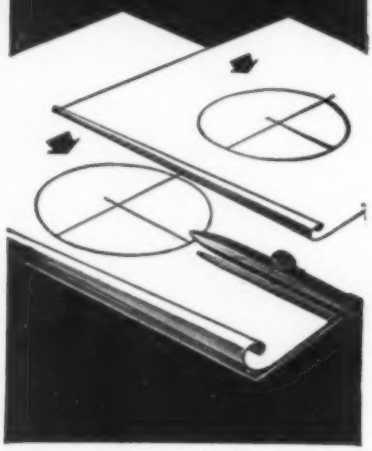
Telescope 9¼" long, dust and dirt free internal focusing — coated optics — erecting eyepiece, and a magnifying power of 20 diameters. Horizontal Limb 5⅝" Dia. with 1 Double Vernier Reading to single minutes. Vertical Circle 4" Dia. with guard. It can be used equally well on long distance or close work.

If you're in the market for a new preliminary precise transit, investigate the David White Model No. 7064-U illustrated above. Compare its many features *and its price* to all others. You'll like what you find out! See our nearest dealer or write direct. Free Bulletin No. 1050 will give you complete details on this and David White's complete line of fine engineering instruments. David White Co., 359 West Court St., Milwaukee 12, Wis.

DAVID WHITE COMPANY

We offer complete, prompt repair service on all makes of instruments — levels, transits, theodolites, etc.

Tracing cloth that defies time



● The renown of Imperial as the finest in Tracing Cloth goes back well over half a century. Draftsmen all over the world prefer it for the uniformity of its high transparency and ink-taking surface and the superb quality of its cloth foundation.

Imperial takes erasures readily, without damage. It gives sharp contrasting prints of even the finest lines. Drawings made on Imperial over fifty years ago are still as good as ever, neither brittle nor opaque.

If you like a duller surface, for clear, hard pencil lines, try Imperial Pencil Tracing Cloth. It is good for ink as well.

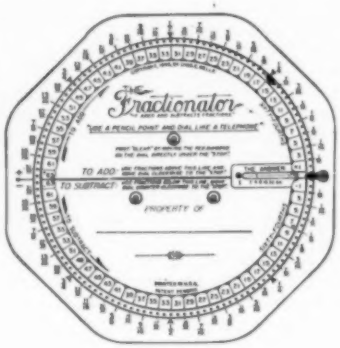
IMPERIAL TRACING CLOTH

SOLD BY LEADING STATIONERY AND DRAWING MATERIAL DEALERS EVERYWHERE

Equipment, Materials & Methods (Continued)

Fractionator

A NEW IDEA CALLED the fractionator, reduces the common nuisance of addition and subtraction of fractions and their interpretation in decimal points to a time saving spin of the dial. This is how it



works. You merely select your fractions on the outer edge of the calibrated circle and dial the answer just as you would your favorite telephone number. It's as simple as that, and accurate up to six figures. So throw away that pencil stub with the well-worn eraser and do your "fractionating" the easy way. For further information write **Charles E. Wells, P. O. Box 25B, Montrose, Calif.**

Back Rip Scarifiers

BACK RIP SCARIFIERS, mounted on the back-side of bulldozer moldboards, which rip the ground when the tractor backs up and float on top of the ground when moving forward, are being introduced. The teeth rip and loosen packed soil, black top and hard ground. They rake out rocks and roots and smooth the ground, making forward blading easier and faster. The equipment does not interfere at any time with blading operations. A set of back rip scarifiers consist of four curved shanks capped lock-on replaceable teeth, each mounted in a separate housing which is welded to the back of the bulldozer moldboard. The teeth are made from the finest steel alloys to insure long life under the most rugged conditions. They can be raised and pinned out of the way when not in use. These rippers have been in use on pioneer road building, in ripping tufa rock, cemented gravel, caliche, decomposed granite, hard clays, stripping operations, and on black top pavement. Back rip scarifiers are available for all standard straight blade bulldozers and are being sold throughout the world by Caterpillar Tractor Co. dealers. For additional information write **Preco, Inc., 6300 E. Slauson Ave., Los Angeles 22, Calif.**

(*Continued on page 94*)

FOUNDATION PILING

This Book Tells The Story...

- Cased Concrete
- Compressed Concrete
- Precast Concrete
- Steel and Pipe
- Composite Concrete
- Wood Piles

Learn more of the Mac Arthur story. You will find it in an eight-page booklet available to you. Information about piles, equipment, and jobs is yours for the writing—just ask for: 'Mac ARTHUR.'

MacArthur
CONCRETE PILE CORP.
18 East 48th Street
New York 17, N. Y.
New Orleans • Cincinnati • Boston

BUSINESS OPPORTUNITY!

HIGHGRADE LIMESTONE QUARRY

FOR SALE

Located on main line railroad in heart of New York State proposed construction belt.

Purchase terms may be arranged.

For details write
Box B195
CIVIL ENGINEERING
33 W. 39th Street
New York, N. Y.

For an engineer what are . . .

"....the most desirable personal characteristics...."

1. INTELLIGENCE

2. DEPENDABILITY

3. ORGANIZATIONAL ACCEPTABILITY

4. ENERGY

5. EMOTIONAL ACCEPTABILITY

6. PHYSICAL ACCEPTABILITY

For a survey by the Engineers' Council for Professional Development, 44 of the nations' top-level engineering executives listed the above six "most desirable personal characteristics" for a successful engineer. The questionnaire results were carefully analyzed and charted by an E.C.P.D. committee. This study is available from Engineers' Council for Professional Development, twenty-five cents each. Larger quantities for use in educational, company personnel, society, etc., work are available at a discount. Send coupon today.

Engineers' Council for Professional Development
29 West 39th Street, New York 18, N. Y.

Enclosed is $.....for.....copies of "The Most Desirable Personal Characteristics"

NAME.....

ADDRESS.....

CITY.....ZONE..... STATE.....

NEW! MODERN! DIFFERENT!

HERE'S EVERYTHING YOU'VE WANTED IN A *HAND LEVEL!*

● No more sliding prisms, vials or mirrors—An end to dismantling the level for adjustment with "missing" screwdrivers.

Your penknife adjusts sleek, STRATEX levels in 30 seconds *(count 'em)* by rotation of optical prism from *outside of instrument!*

● You'll appreciate the "lazy" bubble, STRATEX corundum finish, saddle leather cases, extra light weight of

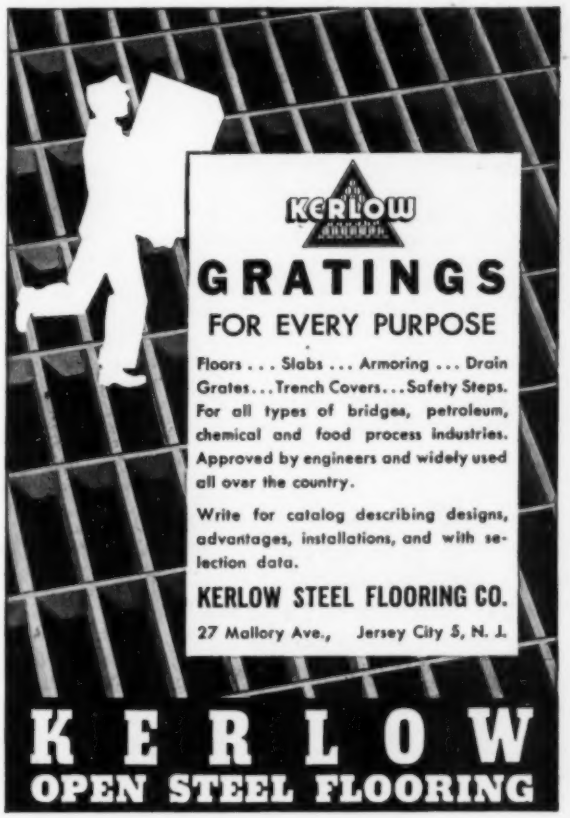
FRANCISCAN STADIA LEVEL, 1:20–$11.50
SILVER CITY LOCKE TYPE LEVEL–$10.00

SEE YOUR DEALER NOW!

DISTRIBUTORS: Pittsburgh, Cleveland, Detroit—*B. K. Elliott;* Washington, DC—*Kinsman Optical;* Los Angeles—*Mohave Sales;* Minneapolis—*O. C. Cluck, 202 So. 10th;* Caracas—*Petroleum Ind. Consltnts;* Havana—*Geol. Engrng. Consltnts.*

If out of stock, order from Dept. 24

STRATEX INSTRUMENT CO.
1861 HILLHURST AVE., LOS ANGELES 27, CALIF. U.S.A.
Mfrs. of Engrs. for SCIENTISTS


KERLOW
GRATINGS
FOR EVERY PURPOSE
Floors . . . Slabs . . . Armoring . . . Drain Grates . . . Trench Covers . . . Safety Steps. For all types of bridges, petroleum, chemical and food process industries. Approved by engineers and widely used all over the country.
Write for catalog describing designs, advantages, installations, and with selection data.
KERLOW STEEL FLOORING CO.
27 Mallory Ave., Jersey City 5, N. J.
K E R L O W
OPEN STEEL FLOORING

Qualified

for any heavy production job

Scoring on three important points; —scientific design, rugged construction and proper installation, Layne Well Water Systems are generously qualified for the heaviest production jobs on record. Furthermore, once installed, these systems keep right on providing good service for years and years. Records show that upkeep cost, in the majority of installations, is almost non-existent. All installations are exclusively by Layne Associated Companies whose engineers and field crews are widely experienced and thoroughly qualified. All contracts cover the job complete, including the final testing of the unit to assure Layne engineers and the buyer that the System is satisfactory in every way. For further information, catalogs, folders, bulletins etc., address

LAYNE & BOWLER, INC.
GENERAL OFFICES, MEMPHIS 8, TENN.

LAYNE

WELL WATER SYSTEMS
VERTICAL TURBINE PUMPS

ASSOCIATED COMPANIES: Layne-Arkansas Co., Stuttgart, Ark. • Layne-Atlantic Co., Norfolk, Va. • Layne-Central Co., Memphis, Tenn. • Layne-Northern Co., Mishawaka, Ind. • Layne-Louisiana Co., Lake Charles, La. • Louisiana Well Co., Monroe, La. • Layne-New York Co., New York City • Layne-Northwest Co., Milwaukee, Wis. • Layne-Ohio Co., Columbus, Ohio • Layne-Pacific, Inc., Seattle, Wash. • The Layne-Texas Co., Ltd., Houston, Texas • Layne-Western Co., Kansas City, Mo. • Layne-Minnesota Co., Minneapolis, Minn. • International Water Corporation, Pittsburgh, Pa. • International Water Supply, Ltd., London, Ont., Can. • Layne-Bigono Americana, S. A., Mexico, D. F. • General Filter Company, Ames, Iowa

Equipment, Materials & Methods (Continued)

Grease Gun

AN AMAZING GREASE GUN has just been placed in factory production, and made available to industry. The Brown portable electric grease gun is a streamlined little machine, 23 in. high, 27½ in. long, mounted on rubber tires and weighing about 230 lb loaded. Twenty-five pounds of grease of any weight, from the heaviest fiberous to the lightest will flow freely through a pressurized tank, even under low temperatures. A modified Ford starter motor develops up to 5 hp power on the pump through a series of gears running in oil. A thumbscrew adjusts a maximum grease pressure, from 500 to 12,000 lb per sq in. This is nozzle pressure. A metering hand nozzle available on this gun can be adjusted to pass a tiny drop, or the largest shot of grease, then stop until the trigger is pulled again. Any standard hand nozzle can be used on the gun. Built in the nose of the gun is a rectifier and drop cord for recharging the guns battery. This small machine is completely portable in that it requires no trailing wires or hoses. Tests have proved that it will grease about 5,000 average fittings before the battery must be recharged. The charging current automatically drops as the battery builds up, and no damage occurs if the charger is left running after the battery is fully charged. A particular important safety feature is a 6-volt power it uses, eliminating completely the possibility of electrocution or injury to the operator, an ingenious double check valve that clears itself of trash in the grease, eliminates most stoppages from this cause. **The Brown Grease Gun Co., Tuckaseegee Rd., Charlotte, N. C.**

Concrete Bucket

A CONCRETE BUCKET designed for handling low slump concrete containing large aggregates and air entraining agents has just been announced. This new circular Model CAC concrete bucket can load and discharge all concrete rapidly and completely. An air-operated clam gate provides positive control and quick action in opening and closing. Part of the load can be deposited in one location and the remainder in another if desired. Rectangular discharge openings prevent arching of concrete over discharge throat. The transition from the circular hopper to the rectangular discharge throat produces hopper slopes which are 70° with the horizontal, with corners that are practically vertical. This bucket has a larger water level capacity and is lighter in weight, yet sturdy enough to withstand the abuse encountered on construction work. Model CAC concrete buckets are furnished in 2, 3, 4 and 8 cu yd sizes. The 8 yd model can be supplied as a two-compartment or single-compartment bucket. Model CAC buckets have been used with highly satisfactory results on big concrete dam construction work. Bulletin 2331 describes the bucket in detail. **Blaw-Knox Co., Farmers Bank Bldg., Pittsburgh, Pa.**

Nearly 50 years of World wide experience. Modern equipment. Trained crews.

Foundation **TEST BORINGS**

★

An Engineering Service For Engineers By Engineers

Literature upon request.

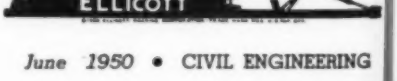
PENNSYLVANIA Drilling CO.
DRILLING CONTRACTORS
PITTSBURGH 20, PA.

DREDGES
ANY TYPE
ANY SIZE
ANY SERVICE

Only Ellicott offers . . .
65 years of experience in dredge building; a *complete line* in all sizes; *undivided responsibility*—your dredge is designed, built and delivered under *one* contract.

ELLICOTT

Write for catalog:
ELLICOTT MACHINE CORPORATION
1607 Bush St., Baltimore 30, Md.



LEADING TECHNICAL PUBLICATION ANALYZES WHY GURLEY ALUMINUM TRANSITS ARE ACCURATE, STRONG, LIGHT, VIBRATION-FREE

The full-length article from which this is reproduced appeared in MODERN METALS. Reprints are available on request.

Gurley Instruments

An article describing the advantages of aluminum construction of Gurley instruments where accuracy, strength, lightness and freedom from vibration are essential.

Probably the controlling incentive in the application of aluminum alloys to surveying instrument construction has been the prospect of weight reduction. Consider the labor to be saved by a surveying party which has to carry these instruments about, day after day, often over rough country, when the weight can be reduced by at least one-third.

A comparison of the mechanical properties of the aluminum alloys with those of the other non-ferrous alloys commonly used in the making of surveying instruments is greatly in favor of the light weight metal. The remarkable feature of these strong aluminum alloys is their high yield point in relation to their ultimate strength, especially those in the fully heat treated condition. They are also very rigid and hard.

Some aluminum alloys are suitable for die-casting. Special bearing metals can be inserted in the molds and cast integral with the structural parts. In no other way have bearing metals and structural metals been so effectively and economically combined. A further result of the use of aluminum alloys through this method of manufacture is a decrease in the number of parts. Minor assemblies have been combined into single parts, permitting more accurate manufacture and insuring a permanence of adjustment of these parts in service. The latter feature is doubly true, since the aluminum alloys differ from other materials of instrument construction in that they do not "grow" nor distort with age.

The non-corrosive and non-tarnishing qualities of aluminum furnish added inducements to their application in the construction of precision instruments. This has led to their substitution for silver on accurately graduated circles and verniers. Burnished aluminum does not blacken when in contact with sulfurous gases frequently found in the atmosphere of mines and industrial districts.

Tests with transits made from aluminum alloys have shown, not only greater structural strength and durability, but greater stability under conditions which induce vibration. That this should be so is readily apparent, since the light weight greatly reduces the momentum of the instrument and consequently the amplitude of vibration.

Gurley transits constructed of the light alloy metals have been used on all kinds of work, meeting successfully the requirements of durability where Transits receive exceedingly rough handling; permanence of adjustment where they are transported over rough roads; a high degree of accuracy where the work is such as to require especially fine graduations; and economy where serious accidents occur which necessitate repairs. Taken all together Gurley's experience with aluminum, covering a period of over 74 years, has been entirely satisfactory and their use of these modern materials is becoming more and more appreciated by the field engineers.

Gurley Transits are guaranteed because: they are engineered and manufactured to exacting standards; all parts are made in the Gurley plant (including all optical components); they are the products of continuous instrument research for more than 104 years.

Write for a copy of our new Catalog 50. It describes all Gurley instruments.

GURLEY
Surveying and Scientific Instrument Makers
Since 1845

W. & L. E. GURLEY, 518 FULTON STREET, TROY, N.Y.

Surveying and Engineering Instruments, Hydraulic Engineering Instruments, Standard Precision Weights and Measures, Paper and Textile Testing Instruments, Reticle Making Facilities, Aeronautical Navigating Instruments and Meteorological Instruments.

AUTOMATIC
Sewage Regulators

Fig. B-19

Automatic Sewage Regulators control sewage flows either by partially or completely cutting off such flows to suit head or tail water conditions or by "governing" to discharge a predetermined quantity regardless of head or tail water conditions.

Descriptive Bulletins and Engineering Data Available Upon Request.

BROWN & BROWN, INC
LIMA, OHIO, U. S. A.

UNDERPINNING AND FOUNDATION CO

FOR 40 YEARS

DIFFICULT FOUNDATIONS
HERCULES STEEL PILES
UNDERPINNING

NO JOB TOO LARGE . . .
. . . NONE TOO SMALL

FREE CONSULTATION

SEND FOR CATALOG

155 E. 44th Street
New York 17, N. Y.

Literature Available

PORTABLE COMPRESSOR—A 6-page 2-color booklet, designated as Bulletin H-850-B71, describes Worthington's Blue Brute 60-ft portable compressor. Diagrams, illustrations, specifications and dimensions are included in this worthwhile offer. **Worthington Pump & Machinery Corp., Harrison, N.J.**

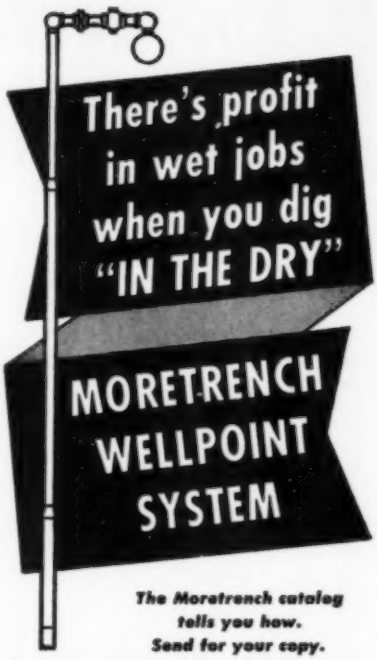
PLYWOOD—Two booklets about Douglas fir plywood and its uses are offered. The 1950 basic catalog for Douglas fir plywood gives the various plywood grades, uses in construction, as well as plywood property information and plywood construction highlights. A reprint from the January issue of "American Builder" discusses plywood in light construction. **Douglas Fir Plywood Assoc., Tacoma Bldg., Tacoma 2, Wash.**

HOISTS—Two new catalogs covering the line of general purpose hoists are profusely illustrated with operating pictures as well as illustrations of mechanical parts and assemblies. Catalog No. 100-H-40 covers general purpose hoists from 5 to 40 hp. Catalog No. 100-H-55 covers hoists from 50 to 100 hp. Copies may be obtained by writing to the **Advertising Dept., American Hoist & Derrick Co., 63 S. Robert St., St. Paul 1, Minn.**

PIPELAYING—Pipeline construction with the giant new International TD-24 and other industrial tractors is featured in an attractive 2-color mailing folder. "International Power for Profitable Pipelaying," offers an interesting roundup of on-the-job action shots from spreads throughout the country, with owner and operator performance reports included in many of the photo captions. Ask for Form No. A-319-NN. **Consumer Relations Dept., International Harvester Co., 180 N. Michigan Ave., Chicago 1, Ill.**

PRUFTITE—Two folders relative to waterproofing masonry surfaces are offered. One folder describes the Pruftite line and includes engineering test reports as well as questions and answers about the use of the Pruftite formulations. "The Skyscraper That Came to Prufcoat" folder tells a rather unusual case history about a well-known New York skyscraper where Pruftite and other Prufcoat formulations have been used. **Prufcoat Laboratories, Inc., 63 Main St., Cambridge 42, Mass.**

STEEL PRODUCTS—Eight colorful new bulletins on Hercules steel products are now available. The purpose of the bulletins is to show customers how Hercules features will help them save time, money and labor. A list of the various bulletins and their form numbers are as follows: Cement Spreader Bulletin—Form 4549, Coal-Handling Power Chute Bulletin—Form 4049, Medium Duty Hoists and Dump Bodies Bulletin—Form 2050, JDX Low-Mount Hydraulic Hoist Bulletin—Form 7550, Line Envelope Stuffer—Form 3549, Split-Shaft Power Take-Off Bulletin—Form 1049, Tire and Tool Pack Dump Body Bulletin—Form 6050 and Fertilizer and Lime Spreader Bulletin. **Hercules Steel Products Corp., Galion, Ohio.**



The Moretrench catalog tells you how. Send for your copy.

MORETRENCH CORPORATION
90 WEST STREET
NEW YORK 6, NEW YORK
Chicago, Ill. - Tampa, Fla. - Houston, Tex.

YOU CAN SAY
"Good-bye to Repair Costs!"
WHEN YOU SPECIFY
IRVING GRATINGS

For—FLOORING
WALKWAYS
BALCONIES
STAIR TREADS, ETC.

In—INDUSTRIAL PLANTS
SEWAGE DISPOSAL PLANTS
REFINERIES
WATER WORKS, ETC.

MADE OF STEEL, ALUMINUM, BRONZE, STAINLESS STEEL, ETC.
Catalog on request

IRVING SUBWAY GRATING—RIVETED TYPE

IRVING SUBWAY GRATING CO., INC.
ESTABLISHED 1902
Offices and Plants at
5008 27th St., Long Island City 1, N. Y.
1819 10th St., Oakland 20, Calif.

Literature Available (Continued)

MEASURING TAPES—Thirty-eight pages of detailed information and illustrations describe the complete line of Starrett steel tapes including pocket tapes, case tapes, frame tapes, oil gaging tapes—in both English and metric graduations—and plumb bobs, tape wipers and tape hooks. Also included are precision leveling instruments, transits and draftsmen's tools—all made to the same high standard of precision. **L. S. Starrett Co., Athol, Mass.**

PERFORATED PIPE—A 24-page illustrated booklet, "Armco Perforated Pipe for Controlling Ground Water," has been published. It describes how harmful ground water can be controlled to provide stable roadbeds and dry subgrades, for airports, streets, recreational areas and industrial sites. Photographs show typical pavement and roadbed failures caused by ground water. Seven pages of diagrams show typical methods of treating subsurface drainage problems. **Armco Drainage & Metal Products, Inc., Middletown, Ohio.**

REFRACTORY CONCRETE—A revised edition of the booklet "Lumnite refractory Concrete" has just been published. Latest available information on refractory and heat-resistant concrete is given. Detailed information on refractory concrete mixes—proportions of Lumnite and various aggregates. From the tables contained in this publication, you can select the proper types of refractory concrete for a wide range of temperatures and insulating conditions. Copies can be obtained from the **Lumnite Div., Universal Atlas Cement Co., Chrysler Bldg., New York 17, N.Y.**

WOOD FRAME CONSTRUCTION—The advantages of wood frame construction for school buildings are shown in a new pictorial brochure, "School Buildings Your Tax Dollars Can Afford." The form of presentation is non-technical with photos and authenticated data that will give local groups a good picture of how the problem is being met in other communities. Tables of comparative costs provide ample facts on the economy of wood frame construction. Copy of the bulletin will be sent free upon request to the **Timber Engineering Co., 1319 18th St., N.W., Washington 6, D.C.**

DIESEL-POWERED TRACTOR—A 287-page service manual featuring HD-19 torque converter equipped crawler has just been released. Instructions include a complete guide on proper operation, maintenance and repair of this new postwar tractor. The book is separated into 23 sections. The portions feature a general description of the tractor, complete specifications, and a detailed pictorial and written description of the various assemblies of the machine, instructions for the proper adjustments and repairs when rebuilding these assemblies, special equipment available, etc. Copies of the manual can be obtained for $5.00 each at **Tractor Div. Service Dept., Allis-Chalmers Mfg. Co., Box 512, Milwaukee 2, Wis.**

NEW FREE BOOK

shows how

creosoted timber piles save money ...assure permanent foundations

Here's a book every engineer should have. It's filled with interesting facts. Graphic descriptions. Photographs of modern construction projects, large and small, that are founded on pressure-creosoted piles.

An interesting book, yes—but informative, too. Case histories tell how substantial savings have been effected and unusual construction problems have been solved by founding permanent structures on creosoted timber piles.

You'll find this book a valuable reference. Send for a copy today. There's no obligation involved.

KOPPERS PRESSURE-TREATED WOOD

KOPPERS COMPANY, INC., Pittsburgh 19, Pa.

Gratings may LOOK alike but.....there's a BIG DIFFERENCE in KLEMP DIAMOND RIVETED OPEN STEEL GRATING

Our grating is different because it's made BETTER...*stronger!* We apply 20 tons of hydraulic pressure to each rivet of our riveted grating to make sure that the grating provides a steady footing, with no weave or rattle. No rivets are ever pounded in by hand. Our 43 years' experience assures perfect fabrication to your specifications. Moreover, we make gratings and open steel meshes *only*, and do not compete with our customers in the iron and structural steel trade.

Send for our new Grating Catalog today!

KLEMP — SURE FOOTED AS A CAT — DIAMOND RIVETED GRATING

WM. F. KLEMP COMPANY

"Steel Flooring Specialists"

6610 S. Melvina Ave. Chicago 38, Illinois

BRONZE SHAFT CAPS averaging 18,000 lbs. each . . .

. . . for New York Board of Water Supply . . .

We are producing many such jobs for various industries. So, if your problem involves any of the following factors: Corrosion Resistance, Strength in Tension and Compression, Hardness and Toughness, Pressure-Tightness, Resistance to Erosion, Resistance to Frictional Wear, Fatigue Resistance . . . be sure to consult us.

Send for our new flexible-bound 46 page Reference Book entitled, "Bronze Casting Alloys." Use your Business Letterhead when requesting it, please.

AMERICAN MANGANESE BRONZE COMPANY

4716 RHAWN ST., HOLMESBURG, PHILADELPHIA 36, PA.

41 YEARS' EXPERIENCE PITTSBURGH PA.

World's Finest! MICRO SURVEYING ALTIMETER

SPEED UP SURVEYS! CUT DOWN COSTS!

MODEL M1 — Intervals of 1' Range 6000' (−1000' to +5000')

MODEL M2 Intervals of 2' Range 10,000' (0' to +10,000')

MODEL M5 Intervals of 5' Range 15,000' (0' to +15,000')

Available in Metric System

ACCURATE DEPENDABLE

All models priced $300 complete with leather case, thermometer, magnifier, operational procedures.

SURVEYING MICRO ALTIMETER

AMERICAN PAULIN SYSTEM

1847 South Flower Street · Los Angeles 15, Calif.

Gratings may LOOK alike but.....there's a BIG DIFFERENCE in KLEMP WELDED OPEN STEEL GRATING

Our grating is different because it's made BETTER...*stronger!* The hexagon crossbars of our welded grating are electro-forged into the carrier bars under 200,000 lbs. pressure and 1500 KVA. This provides a one-piece assembly *without notches*, that can't come apart. Our 43 years' experience insures perfect fabrication to your specifications. Moreover, we make gratings and open steel meshes *only*, and do not compete with our customers in the iron and structural steel trade.

Send for our new Grating Catalog today!

KLEMP — SURE FOOTED AS A CAT — OPEN STEEL FLOORING

WM. F. KLEMP COMPANY

"Steel Flooring Specialists"

6610 S. Melvina Ave. Chicago 38, Illinois

PROCEEDINGS PAPERS
AVAILABLE AS SEPARATES

THE FOLLOWING PAPERS, printed as Proceedings Separates, may be ordered on the basis of summaries given in this and previous issues of CIVIL ENGINEERING. Discussions of these papers will be received, as in the past. A summary of each paper appears in three consecutive issues; others will be added every month, as they become available. Use the convenient order form on page 100.

Summarized in Earlier Issues

1. Improvements at the Back River Sewage Works, Baltimore, Md., by C. E. Keefer, M. ASCE.

2. Public Utility Condemnation Cases in the State of Washington by Henry L. Gray, M. ASCE.

3. Treatment of Foundations of Large Dams by Grouting Methods by A. W. Simonds, M. ASCE, Fred H. Lippold, M. ASCE, and R. E. Keim, Assoc. M. ASCE.

4. Capillary Phenomena in Cohesionless Soils by T. William Lambe, Jun. M. ASCE.

5. Elastic Restraint Equations for Semi-Rigid Connections by J. E. Lothers, M. ASCE.

6. Slope Deflection Equations for Curved Members by Keith T. Fowler, Jun. M. ASCE.

7. The Geochemistry of Earthwork by Hyde Forbes, M. ASCE.

8. Floating Tunnel for Long Water Crossings by Charles E. Andrew, M. ASCE.

9. Atchafalaya River Diversion and Its Effect on the Mississippi River by Leo M. Odom, M. ASCE.

10. Pollution Abatement Policy by Thomas R. Camp, M. ASCE.

11. Long-Term Storage Capacity of Reservoirs by H. E. Hurst.

12. Influence Charts for Concrete Pavements by Gerald Pickett and Gordon K. Ray, Jun. M. ASCE.

13. Reinforced Concrete Skewed Rigid-Frame and Arch Bridges by Maurice Barron, M. ASCE.

14. Mathematical Analysis of an Aerial Survey by Lo-Ho.

15. Computation of Equitable Charges for Treatment of Municipal Sewage by Ellis E. Bankson, M. ASCE.

D-VII Discussion of Paper, **Deflection of Plywood Beams Due to Moisture Content Change,** by W. E. Wilson and Laurence G. Olson.

Third Notice

16. Pavement Bearing Capacity Computed by Theory of Layered Systems by Guthlac Wilson, M. ASCE, and G. M. J. Williams, Jun. M. ASCE. A new method, based on the theory of elastic layered systems, for estimating the bearing capacity of road and airfield pavements, is described in this paper. It is applicable to both rigid and flexible pavements. All the important properties of the materials comprising the pavement and subgrade can be taken into account including pre-existing stresses in the subgrade. Charts are obtained from which the required pavement thickness can be read directly, if the loading and the physical properties of the subgrade and pavement are known. The more commonly used methods for computing pavement thicknesses are discussed and compared, particularly in so far as they permit consideration of the various factors entering the problem. (Available June 1.)

17. Origin and Significance of Openwork Gravel by Allen S. Cary, Assoc. M. ASCE. Stream deposits of "openwork" pebbles and boulders without interstitial sand were responsible for leakage which led to the failure of the Cedar Reservoir in Washington. The very common occurrence of "openwork" gravel in the Pacific Northwest led to a study of its origin, distribution, and effect on the design of dams, levees, and other works involving water. The right abutment of the Chief Joseph Dam on the Columbia River in Washington consists of a 100-ft-thick bed of extremely pervious openwork gravel resting on bedrock 20 ft below river level and overlain by a very dense impervious bed of glacial till hardpan. The high permeability and the poor grading of the gravel pose a difficult problem of unwatering the right abutment during construction and of controlling seepage after completion. (Available June 1.)

18. Successive Approximations for Beams on an Elastic Foundation by E. P. Popov, Assoc. M. ASCE. A general method for solving problems of beams on an elastic foundation is given in this paper. Complex problems with variable moment of inertia of the beam and variable foundation modulus can be solved with relative ease by the proposed method. The procedures used are simple and are based on the well known moment-area or conjugate beam method of analysis. The difficult mathematics that occur in the usual solution of such problems are completely avoided. The proposed method should find practical applications in structural and foundation work. Even junior members of the profession can master the method quickly. Detailed examples solved in the paper illustrate the method. (Available June 1.)

19. Flood-Control Operation of Tennessee Valley Authority Reservoirs by Edward J. Rutter, M. ASCE. After engineering projects are completed, it is always of great interest to know whether or not they will function as planned. In the case of flood-storage reservoirs, it may be many years before a flood occurs which is large enough to test the planned operations. Recent floods in 1946, 1947, and 1948 provided such a test for the large system of reservoirs constructed by the Tennessee Valley Authority. Actual operations of the tributary and main Tennessee River reservoirs during those floods are described, and comparisons of actual flows with computed natural flows are shown in tabulations of crests and by graphs. Comparisons with hypothetical "fixed rule" and "ideal" operations are made to determine the efficiency of the actual operations. The paper also discusses the effect of tributary reservoirs and main-river reservoirs considered as groups. (Available June 1.)

20. Three-Dimensional Displacement Diagrams for Space Frame Structures by Walter Worthington Ewell, Jun. M. ASCE. The Williot-Mohr displacement diagram is an invaluable aid in the analysis of planar structures—yielding intrinsically important joint displacements, facilitating the construction of influence lines for redundant elements, and simplifying the calculations of secondary stresses in trusses. The space displacement diagram developed in this paper determines the movements of space frame joints along the three coordinate axes of space and lends itself to applications similar to those realized with the planar Williot-Mohr diagram. Three-dimensional displacement diagrams are presented for a simple space pedestal and for a second-degree indeterminate

INSTRUCTIONS

1. Papers are to be ordered by serial number. Please keep record of Separates you have ordered to avoid unwanted duplication.

2. Any ASCE member may order a total of 25 copies of papers during the fiscal year ending September 30, 1950, without charge. These may be duplicates of the same paper, separate papers, or a combination of both.

3. Members accounts will be charged at 25¢ each for orders exceeding 25 copies in a fiscal year. Charges for excess copies or for subscriptions will be included on the 1951 dues bills.

4. Non-members of the Society may order copies of PROCEEDINGS papers by letter with remittance of 50¢ per copy; members of Student Chapters 25¢ per copy.

5. Discussions of each paper with authors closure, also will be published as a Separate and must be ordered in the same manner as other separates, except that no charge will be made for the discussions of a paper previously ordered. The order form will list available discussions of papers. Discussions will be numbered to agree with the basic paper.

Standing orders for all Separate papers, including discussions, may be entered at the following annual rates: Members of ASCE, $3.00; members of Student Chapters, $5.00; non-members, $10; libraries, $5.

TRANSACTIONS. All PROCEEDINGS papers, with discussions, will be included in TRANSACTIONS. Annual volumes of TRANSACTIONS will continue to be available at the currently established annual subscription rates.

	To Members	To Non-Members
Leather binding	$4.00	$18.00
Cloth binding	3.00	17.00
Paper binding	2.00	16.00

space truss. The graphical examples are illustrated progressively in three separate phases to clarify all construction principles, including the use of a rotational correction diagram. (Available June 1.)

Second Notice

21. Maximum Load Capacity of Bailey Bridges by Robert B. Stegmaier, Jr., Jun. M. ASCE. Structural sections for standard Bailey bridges were made in large quantities during World War II, by mass production. In military situations, where a bridge was already in place, it was important to know the maximum load capacity so that any necessary added strength could be provided by the most efficient use of available bridging materials. The paper describes the application of test results obtained by loading prototype bridges to failure. Three types of maximum load were established for each type and span of bridge, based on traffic regulations: For control, caution, and risk crossings. For control crossings traffic regulations were liberal. Risk crossings were closely regulated because of the more immediate possibility of failure. The departure from the normal analytical methods for the determination of highway bridge capacity is unusual. The methods described could be applied to any standardized structure. (Available July 1.)

22. Specifications for Heavy Duty Structures of High-Strength Aluminum Alloy, Progress Report of the Committee of the ASCE Structural Division on Design in Lightweight Structural Alloys. These specifications cover allowable stresses, design rules, and fabricating procedures for riveted heavy-duty structures built of the high-strength aluminum alloy known commercially as 14S-T6. The basic allowable tensile working stress is 22,000 lb per sq in. based on a minimum yield strength of 53,000 lb per sq in. and a minimum tensile strength of 60,000 lb per sq in. The manuscript for the specifications has been approved by the Executive Committee of the Structural Division. (Available July 1.)

23. Influence of Heavy Loads on Pavement Design Trends by K. B. Woods, M. ASCE. Data for this paper were obtained from a review of the literature and are evaluated in the light of research at Purdue University in West Lafayette, Ind., on soils, climate, traffic, and materials, since these variables relate to the performance of pavements in primary roads. Emphasis is placed on structural failures of rigid pavements and the rutting of flexible pavements. It is concluded that maximum-weight requirements must be strictly enforced, that the prevailing legal axle-load limits must not be increased, and that large-scale research must be initiated to study the economical design of the truck-pavement combination. Research is also needed to develop better methods of compacting base course materials for flexible pavements; and experimental work is necessary to evaluate the use of thick slabs with heavy reinforcement or the use of slabs with commonly employed thicknesses, constructed with various types and thicknesses of base course. (Available July 1.)

24. Summary of Buckling of Rigid-Jointed Plane Trusses by N. J. Hoff, Bruno A. Boley, S. V. Nardo, and Sara Kaufman. It is known that the buckling load of a compression member of a framework depends largely on the elastic restraint provided by the adjacent members. Recent investigations have shown that the restraining effect can be calculated rigorously. It is demonstrated that the rigidity of the gusset plates results in a sizable increase in the buckling load. The magnitude of the gusset plate effect can be determined with the aid of the diagrams presented in this paper Experiments are described corroborating the theoretical conclusions. (Available July 1.)

25. Uplift Pressures in Concrete Dams by Kenneth B. Keener, M. ASCE. Measurements of uplift pressures in concrete dams, including analysis and keeping of complete records, are justified. A thorough description is given of the installation and location of equipment used in observing uplift. Methods of relieving excessive foundation uplift pressures are cited. A case history of the uplift at Hoover Dam is included, both prior to and after measures were undertaken to reduce foundation pressures. Results of long-time observations at other dams constructed by the Bureau of Reclamation are indicated. It is concluded that design assumptions for uplift more in keeping with actual observations would result in smaller transverse cross sections and thereby in an appreciable reduction in cost of concrete dams. (Available July 1.)

First Notice

D-XVI. Discussion of Paper, **Stream Flow Variability,** by E. W. Lane and Kai Lei. The original paper, published in September 1949 PROCEEDINGS (p. 935), introduced an index of stream flow variability in the form of the standard deviation of the logarithm of the stream discharge. Discussers are: Ven Te Chow, Dana M. Wood, H. Alden Foster, C. S. Ospina and G. Tama, Raphael G. Kazmann, Jack Bruin and H. E Hudson, Jr., H. W. Lull, William D. Mitchell, C. R. Ownbey, S. P. Wing, J. E. McKee, and G. B. Schroyer and E. T. Schuleen. Mr. Lane wrote the closing arguments, Mr. Lei being inaccessible because of current disturbed conditions in China. (Available August 1.)

D-XVII. Discussion of Paper, **End Restraints on Truss Members,** by Harold E. Wessman and Thomas C. Kavanagh. The original paper, published in September 1949 PROCEEDINGS (p. 951), presented a method of computing end restraints and the effective lengths of compression members under different load conditions. An important conclusion was that when a truss buckles all members tend to fail simultaneously. Critical and constructive comment was received from Jack R. Benjamin, George Winter, Abraham Slavin, J. Edmund Fitzgerald, Joseph S. Newell, and Charles W. Dohn. The authors' closure should be read with interest by everyone concerned with the practice and theory of structures. (Available August 1.)

D-XVIII. Discussion of Paper, **Frequency Analysis of Beam and Girder Floors,** by Hans H. Bleich. The original paper, published in October 1949 PROCEEDINGS (p. 1093), proposed a method for finding the vibration frequencies and modes in three-dimensional structures such as floor systems, multi-story building frames, and airplanes. A brief discussion by Robert V. Hauer, with an answering comment from Mr. Bleich, constitutes the total scope of this Separate. (Available August 1.)

D-XIX. Discussion of Paper, **Roads and Pavements, Sampson Naval Training Station,** by Jacob Feld. The original paper, published in October 1949 PROCEEDINGS (p. 1133), gave a full description of the construction of 65 lane-miles of roads, within a period of six months. Valuable discussion is presented by P. F. Phelan, which calls for a brief closing comment by the author. (Available August 1.)

D-XX. Discussion of Paper, **Aerodynamic Theory of Bridge Oscillations,** by D. B. Steinman. The original paper, published in October 1949 PROCEEDINGS (p. 1147), presented general equations for the determination of vertical, torsional, and coupled oscillations on any structural section of two degrees of freedom. Numerical and graphical examples illustrate the practical application of the underlying theory. Discussers are: David J. Peery, Alexander Klemin, Abraham Slavin, Charles W. Dohn, Boris A. Bakhmeteff, F. J. Maher and J. B. Eades, Edmund Pinney, Harold A. Thomas, Elmo G. Peterson, William Allan, Paul Lieber, S. K. Ghaswala, Peter L. Tea, Edward Adams Richardson, H. H. Bleich, F. B. Farquharson, and George S. Vincent. The author's reply is comprehensive and thorough. (Available August 1.)

For the Use of ASCE Members Only 1950
PROCEEDINGS PAPERS ORDER FORM

AMERICAN SOCIETY OF CIVIL ENGINEERS

33 W. 39 ST., NEW YORK 18, N. Y.

Enter my order for Separate PROCEEDINGS Papers which I have circled below:

Paper No. 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
20 21 22 23 24 25 D-VII D-XVI D-XVII D-XVIII D-XIX D-XX

If more than one copy of a paper is desired, indicate here

Name (Please Print) Membership Grade

Address

Signature Date

Professional Services

listed alphabetically by states

EWIN ENGINEERING CORPORATION
Design and Construction
Investigations Reports Appraisals, Estimates and Management Surveys, Port Facilities, Foundations, Industrial Plants. Bridges and Structures.
P. O. Box 361 **Mobile 3, Ala.**

PALMER & BAKER, INC.
Consulting Engineers for:
Problems of Transportation, Subaqueous Vehicular Tunnels, Rock Tunnels, Utility Tunnels, Bridges, Grade Separations, Highways, Airports, Traffic Studies, Parking Problems, Waterfront & Harbor Structures
Mobile, Alabama

JOHN S. COTTON
Consulting Engineer
Hydroelectric, water supply, and multiple purpose projects, flood and erosion control, river basin development planning, dams and their foundations, tunnels, marine structures, valuations, rates.
28 Brookside Drive, San Anselmo, Calif.

DAMES & MOORE
Soil Mechanics Investigations
General Offices
816 West Fifth Street
Los Angeles 13
Regional Offices in
Los Angeles • San Francisco • Portland • Seattle • New York

FRED C. SCOBEY
Consultant on hydraulic problems: Water conveyance in pipes, canals, tunnels and flumes, with or without measuring devices. Equivalent sizes, aqueducts of various materials, based on their limitations. Critical review, plans and specs. Suggestions for improving impaired capacity. Know high velocity structures.
1063 Euclid Ave., **Berkeley 8, Calif.**

KAISER ENGINEERS
Division of Kaiser Industries, Inc.
ENGINEER – CONTRACTOR
Investigations – Reports – Valuations
Design – Construction
Twinoaks 3-4600
1924 Broadway **Oakland, Calif.**

O. J. Porter & Company
CONSULTING ENGINEERS
Airports—Highways—Dams
Foundation—Stabilization—Pavements
516 9th St.
Sacramento, Cal.
50 Church St. **415 Frelinghuysen Ave.**
New York City **Newark, N. J.**

CHARLES B. McADAM
Consulting Engineer
Geodetic Cartographic
Topographic Photogrammetric
Hydrographic Harbors
General Domestic and Latin American
117 Arcade Building **P. O. Box 817**
Fort Pierce, Florida

KIDDER & THOMA
Cadastral Engineers
Large Scale Cadastral Surveys
Riparian Rights, Boundary Locations
Preparation for Trial of Suits, Consultations
Joseph C. Thoma
4811 Blagden Avenue, N. W.
Washington 11, D. C.

ALVORD BURDICK & HOWSON
Charles B. Burdick
Louis R. Howson **Donald H. Maxwell**
Consulting Engineers
Water Works, Sewerage, Water Purification, Sewage Treatment, Flood Relief, Power Generation, Drainage, Appraisals.
20 North Wacker Drive, Chicago 6, Ill.

CONSOER, TOWNSEND & ASSOCIATES
Water Supply, Sewerage, Flood Control & Drainage, Bridges, Express Highways, Paving, Power Plants, Appraisals, Reports, Traffic Studies, Airports
351 East Ohio Street, Chicago 11, Ill.

DeLEUW, CATHER & COMPANY
Consulting Engineers
Transportation, Public Transit and Traffic Problems
Industrial Plants, Grade Separations, Railroads, Subways, Power Plants, Expressways, Tunnels, Municipal Works
150 N. Wacker Drive, 79 McAllister St.
Chicago 6 **San Francisco 2**

GREELEY AND HANSEN
Engineers
Water Supply, Water Purification
Sewerage, Sewage Treatment
Flood Control, Drainage, Refuse Disposal
220 So. State Street, Chicago 4, Ill.

HARZA ENGINEERING COMPANY
Consulting Engineers
L. F. Harza
E. Montford Fucik **Calvin V. Davis**
Hydro-Electric Power Projects
Transmission Lines, System Management, Dams, Foundations, Harbor Structures, Soil Mechanics
400 W. Madison St., Chicago 6, Ill.

SOIL TESTING SERVICES, INC.
Foundation Borings
Field and Laboratory Tests of Soils
Analyses and Reports
Soil Testing Apparatus
525 N. Noble Street
Chicago 22, Ill.

JENKINS, MERCHANT & NANKIVIL
Consulting Engineers
Water Systems Municipal Improvements
Power Development Sewerage
Flood Control Industrial Plants
Traffic Surveys Recreational Facilities
Airports Investigations and Reports
805 East Miller Street
Springfield, Illinois

WILBUR M. WILSON
Consulting Structural Engineer
Plans Reviewed. Existing Structures Inspected. Design and Inspection Problems in Structural Fatigue and Structural Welding A Specialty
119 Talbot Laboratory, Urbana, Illinois

STANLEY ENGINEERING COMPANY
Consulting Engineers
Airports—Drainage—Electric Power
Flood Control—Industrial Rate Studies
Sewerage — Valuation — Waterworks
Hershey Building, Muscatine, Iowa

HAZELET & ERDAL
Consulting Engineers
Bridges — Foundations —
Expressways — Dams — Reports
Monadnock Block
Chicago
Heyburn Bldg. **Dixie Terminal Bldg.**
Louisville **Cincinnati**

SAXE, WILLIAR & ROBERTSON
Engineers—Consultants
Bridges—Structures—Foundations
Industrial Buildings
Investigations—Designs—Specifications
Supervision of Construction
Richmond, Va. **Baltimore, Md.**

WHITMAN REQUARDT AND ASSOCIATES
Engineers
Sewerage and Water Systems, Airports, Industrial and Power Plants and Other Structures
Reports — Designs — Specifications — Supervision
1304 St. Paul Street, Baltimore 2, Md.

CRANDALL DRY DOCK ENGINEERS, INC.
Railway Dry Docks, Floating Dry Docks, Basin Dry Docks, Shipyards, Port Facilities
Investigation, Reports, Design, Supervision
238 Main St., Cambridge 42, Mass.

IRVING B. CROSBY
Consulting Engineering Geologist
Investigations and Reports
Dams, Reservoirs, Tunnels, Foundations, Groundwater Supplies and Resources
Non-Metallic Minerals
6 Beacon Street
Boston 8, Massachusetts

CHAS. F. DINGMAN
Engineer
Consultant on Construction Cost
Valuation of Physical Assets
Estimates of Const. of
Projected Construction or Expansion
Established 1925
Palmer, Mass.

DRUMMEY-DUFFILL, INC.
Architects—Engineers
80 Boylston St., Boston 16, Mass.

FAY, SPOFFORD & THORNDIKE
Engineers
Charles M. Spofford **Ralph W. Horne**
John Ayer **Frank L. Lincoln**
Bion A. Bowman **William L. Hyland**
Carroll A. Farwell **Howard J. Williams**
Bridges and Industrial Plants
Water Supply and Sewerage Works
Port and Terminal Works, Airports
Boston **Seattle** **New York**

USE THIS PROFESSIONAL CARD DIRECTORY

Participation is restricted to consulting engineering firms operated or controlled by members of the American Society of Civil Engineers

Your card should be among them.
Write Today For Rates.

Additional Professional Cards On Pages 102 and 103.

Professional Services

listed alphabetically by states

METCALF & EDDY
Engineers
Investigations Reports Design
Supervision of Construction
and Operation
Management Valuation Laboratory
Statler Building, Boston 16 — 111 Sutter St, San Francisco 4

BENJAMIN S. SHEINWALD
Architectural Consultants
on
Engineering Projects
Design—Supervision—Reports
85 South Street, Boston 11, Mass.

THE FRANCIS ENGINEERING COMPANY
Consulting Engineers
Water Works, Water Treatment, Sewerage, Sewage Treatment, Flood Control and Drainage, Concrete and Steel Structures, Light and Power. Investigations—Reports—Design—Supervision
Eddy Building, Saginaw, Michigan
Cutler Building, Rockford, Illinois
Johnson Building, Escanaba, Michigan

ANDREW M. KOMORA
Consulting Engineer
Dams, Tunnels,
Underground Powerhouses
Hydro-Electric Projects
31 Valhalla Drive, Ann Arbor, Michigan

HITCHCOCK & ESTABROOK, INC.
Lester D. Lee, Associate
Consulting Engineers since 1920.
Water, Sewerage, Paving, Power Plants, Airports, Buildings, Reports & Appraisals
521 Sexton Building
Minneapolis 15, Minn.

EUSTIS ENGINEERING COMPANY
FOUNDATION and SOIL MECHANICS INVESTIGATIONS
Soil Borings—Laboratory Tests
Analysis—Designs—Reports
922 Grove St. — Vicksburg, Miss.
556 Jefferson Pk. Ave., New Orleans, La.

BLACK & VEATCH
Consulting Engineers
Water—Sewage—Electricity—Industry
Reports, Design Supervision of Construction Investigations, Valuation and Rates
4706 Broadway — Kansas City 2, Mo.

BURNS & McDONNELL ENGINEERING CO.
Consulting Engineers 50th Year
Waterworks, Light and Power, Sewerage Reports, Designs, Appraisals, Rate Investigations
Box 7088 Country Club P. O.
Kansas City, Mo.

A. L. ALIN
Consulting Engineer
5927 N. 24 St.
Omaha, Nebraska
Dams, Hydroelectric Power
Flood Control

EDWARDS AND KELCEY
Engineers
Surveys—Reports—Economic Studies—Design—Supervision
Transportation—Traffic—Parking—Terminals
Highways—Expressways—Grade Separations—Tunnels—Bridges—Water Supply
3 William Street, Newark 2, New Jersey

CLINTON L. BOGERT ASSOCIATES
Consulting Engineers
Clinton L. Bogert — Ivan L. Bogert
J. M. M. Greig — Robert A. Lincoln
Donald M. Ditmars — Arthur P. Ackerman
Water and Sewage Works
Refuse Disposal — Industrial Wastes
Drainage — Flood Control
624 Madison Avenue, New York 22, New York

BOWE, ALBERTSON & ASSOCIATES
Engineers
Water and Sewage Works
Industrial Wastes—Refuse Disposal—Municipal Projects
Airfields—Industrial Buildings
Reports—Designs—Estimates
Valuations—Laboratory Service
110 William St., New York 7, N.Y.

JAMES M. CAIRD
Established 1898
C. E. Clifton, H. A. Bennett
Chemist and Bacteriologist
Water Analysis
Tests of Filter Plants
Cannon Building, Troy, N. Y.

CHRISTIANI & NIELSEN
ENGINEERS
Harbor Works Bridges Foundations Industrial Buildings Power Plants Dams Tunnels Highways Railroads
350 Fifth Ave., New York 1, N. Y.
Buenos Aires Rio de Janeiro Lima Montevideo Caracas Mexico Bogota Paris London The Hague Stockholm Oslo Copenhagen Cape Town Bangkok

FRANKLIN D. COOPER
Consulting Engineer
Foundations—Design—Investigation
321 Lansdowne Road — Dewitt, N. Y.

FRANK L. EHASZ
Consulting Engineer
Structures, Bridges, Airports, Parkways
Design, Supervision of Construction
Investigations, Reports
82 Beaver Street — New York 5, N. Y.

HARDESTY & HANOVER
Consulting Engineers
Successors to Waddell & Hardesty
Long Span and Movable Bridges, Hanover Skew Bascule, Grade Eliminations, Foundations, Other Structures, Supervision, Appraisals, and Reports.
101 Park Avenue, New York 17, N. Y.

HOWARD, NEEDLES, TAMMEN & BERGENDOFF
Consulting Engineers
Bridges and Structures
Foundations, Highways
Administrative Services
921 Walnut Street — 55 Liberty Street
Kansas City 6, Mo. — New York 5, N. Y.

KNAPPEN TIPPETTS ABBETT ENGINEERING CO.
Ports, Harbors, Flood Control Irrigation Power, Dams, Bridges, Tunnels, Highways
Subways, Airports, Traffic, Foundations, Water Supply, Sewerage, Reports, Design, Supervision, Consultation
62 West 47th Street, New York City

R. M. LEGGETTE
Consulting Ground Water Geologist
Water Supply, Salt Water Problems, Dewatering, Recharging, Investigations, Reports.
551 Fifth Avenue, New York 17, N. Y.

HAROLD M. LEWIS
Consulting Engineer City Planner
Municipal & Regional Planning
Zoning—Subdivisions
Traffic—Parking
Urban Redevelopment
Airports—Related Problems
Plans—Reports—Ordinances
15 Park Row — New York 7, N. Y.

LOCKWOOD, KESSLER & BARTLETT, INC.
Engineers—Surveyors
General Engineering Services
Aerial and Ground Surveys
Photogrammetric Mapping
Domestic and Foreign
32 Court St. — Brooklyn 2, N. Y.

MORAN, PROCTOR, FREEMAN & MUESER
Consulting Engineers
Foundations for Buildings, Bridges and Dams, Tunnels, Bulkheads, Marine Structures, Soil Studies and Tests, Reports, Design and Supervision.
420 Lexington Ave., New York 17, N. Y.
AP. Cor. 614, Caracas, Venezuela

PARSONS, BRINCKERHOFF, HALL & MACDONALD
Engineers
Airports, Bridges, Tunnels, Highways
Traffic & Transportation Reports,
Subways, Foundations, Harbor Works,
Valuations, Power Developments,
Industrial Buildings
Dams, Sewerage, Water Supply
51 Broadway, New York 6, N. Y.

MALCOLM PIRNIE ENGINEERS
Civil & Sanitary Engineers
Malcolm Pirnie — Ernest W. Whitlock
Richard Hazen — G. G. Werner, Jr.
Investigations, Reports, Plans
Supervision of Construction
and Operations
Appraisals and Rates
25 W. 43rd Street, New York 18, N. Y.

THE PITOMETER COMPANY
Engineers
Water Waste Surveys, Trunk Main Surveys, Water Distribution Studies
Water Measurements & Tests
Water Wheels, Pumps, Meters
50 Church Street, New York 7, N. Y.

ALEXANDER POTTER ASSOCIATES
Consulting Engineers
Water Works, Sewerage, Drainage. Refuse Incinerators, Industrial Wastes, City Planning.
50 Church Street, New York 7, N. Y.

SEELYE, STEVENSON & VALUE
Consulting Engineers
Successors to
Elwyn E. Seelye & Co.
Airports, Soil Surveys, Bridges, Stadiums, Docks, Concrete, Highways, Steel, Welding Foundations, Industrial Buildings
101 Park Ave., — New York 17, N. Y.

OLE SINGSTAD
Consulting Engineer
TUNNELS
Investigations, Reports, Design
Specifications, Supervision
24 State St., — New York 4, N. Y.

FREDERICK SNARE CORPORATION
Engineers-Contractors
Harbor Works, Bridges, Power Plants Dams, Docks and Foundations
233 Broadway, New York 7, N. Y.
1400 South Penn Square, Philadelphia
Santiago, Chile — San Juan, P. R.
Havana, Cuba — Lima, Peru
Bogota, Colombia — Caracas, Venezuela

D. B. STEINMAN
Consulting Engineer
Bridges
Design, Construction, Investigation, Reports, Strengthening, Advisory Service
117 Liberty Street, New York 6, N. Y.

THE J. G. WHITE ENGINEERING CORPORATION
Design, Construction, Reports, Appraisals
Eighty Broad Street, New York 4, N. Y.

THE AUSTIN COMPANY
Design — Construction — Reports
Plant Location Surveys—Domestic & Foreign Work
16112 Euclid Avenue, Cleveland, Ohio
New York — Detroit — Oakland
Chicago — Houston — Seattle
Los Angeles

WALL & NEFF
Professional & Consulting Engineers
George S. Wall — Cyril W. Neff
City Planning, Housing Projects, Hotels, Apartment Buildings.
Surveys, Planning, Design, Inspection, Reports
20863 Stratford Ave., Cleveland 16, Ohio

Additional Professional Cards on Preceding Page.

Professional Services

listed alphabetically by states

HAVENS AND EMERSON
W. L. Havens C. A. Emerson
A. A. Burger F. C. Tolles F. W. Jones
Consulting Engineers
Water, Sewerage, Garbage, Industrial Wastes, Valuations—Laboratories
Leader Bldg. Cleveland 14, O. Woolworth Bldg. New York 7, N. Y.

ALBRIGHT & FRIEL, INC.
Consulting Engineers
Francis S. Friel
Water, Sewage and Industrial Waste Problems, Airfields, Refuse Incinerators, Industrial Buildings, City Planning, Reports, Valuations—Laboratory.
121 So. Broad Street, Philadelphia 7, Pa.

GANNETT FLEMING CORDDRY & CARPENTER, INC.
Engineers
Water Works, Sewage, Industrial Wastes and Garbage Disposal—Roads, Airports Bridges and Flood Control—Town Planning, Appraisals, Investigations and Reports
Harrisburg, Pa. Pittsburgh, Pa.
Scranton, Pa.

GILBERT ASSOCIATES, INC.
Engineers and Consultants
Surveys—Design—Supervision
Domestic and Foreign
Industrials and Utilities
412 Washington Street, Reading, Pa.

HUNTING, LARSEN & DUNNELLS
Engineers
Industrial Plants—Warehouses—Commercial Buildings—Steel and Reinforced Concrete—Design—Supervision—Reports
1150 Century Bldg., Pittsburgh 22, Pa.

JUSTIN & COURTNEY
Consulting Engineers
Joel B. Justin Neville C. Courtney
Dams and Power Problems
Hydro Electric Developments
Foundations
121 S. Broad St., Philadelphia 7, Pa.

MODJESKI AND MASTERS
Consulting Engineers
F. M. Masters
G. H. Randall J. R. Giese
C. W. Hanson H. J. Engel
Design and Supervision of Construction
Inspection and Reports
Bridges, Structures and Foundations
535 Fifth Ave. New York, N. Y.
State St. Bldg. Harrisburg, Pa.

THE VIBRATION ENGINEERING COMPANY
Consultants on Vibration Effects
Blasting Operations Monitored for Safe Limits Using Leet Portable Seismographs
Dr. L. Don Leet & Harold H. White
131 North Wyoming Street
Hazleton, Pa.

MORRIS KNOWLES, INC.
Engineers
Water Supply and Purification
Sewerage and Sewage Disposal
Valuations, Laboratory, City Planning
1312 Park Bldg., Pittsburgh 22, Pa.

More and More Members of the Society are using this Service. Is Your Card Here?

THE McPHERSON COMPANY
Engineers and Architects
Design Power Plants
Supervision of Construction Reports
Industrial Plants Appraisals
Greenville, South Carolina

H. S. MATTIMORE
Engineering Consultants
Investigations, Reports, Specifications
Concrete Construction
Highway and Airport Pavements
Materials and Research Planning
4226 Elmerton Ave., Colonial Park, Pa

GREER & MCCLELLAND
Consulting Foundation Engineers
Foundation Investigations—engineering soil testing—undisturbed sampling and core drilling.
2649 N. Main Houston 9, Texas

LOCKWOOD & ANDREWS
Consulting Engineers
Airports, Paving, Industrial Plants, Drainage & Sewerage, Water Supply, Soils & Foundations, Power Plants, Structures, Harbor Works, Valuations
Reports—Design—Supervision
Houston, Texas

R. J. PUTNEY
Consulting Engineer
Flood Control Drainage
Subdivision Municipal
1503 Hadley Ave. Houston, Texas

WALTER J. RYAN
Consulting Engineer
Pacific Northwest Industrial Development
Transportation—Timber
901 Rust Building Tacoma 2, Washington

ENGINEERING as a CAREER

A MESSAGE TO YOUNG MEN, TEACHERS AND PARENTS

This pamphlet has been prepared as an educational guide, in order to give something of an introductory insight into the profession of engineering. It is dedicated to the coming generation of engineers and to the constructive contributions which they will make to the life and culture of mankind. Contents of the booklet have been divided into three main parts: The Scope of Engineering; Principal Branches of Engineering; and References to Vocational Guidance Literature.

PRICE $0.15 ($10.00 per 100)

ORDER NOW—USING THE COUPON BELOW

Engineers' Council for Professional Development
29 West 39th Street New York 18, N. Y.

Please forward a copy of "Engineering as a Career." Payment is enclosed.

NAME.....

ADDRESS.....

CITY.....

HYDROLOGY HANDBOOK

Just off the Presses as
SOCIETY MANUAL NO. 28
192 pages

Authoritative reference in a growing field

Thirty-three specialists have collaborated to present up to date coverage on

Precipitation **Infiltration**
Ground Water Storage **Run-Off**
Evaporation and Transpiration

This valuable text and reference is now available. Use this handy order blank

American Society of Civil Engineers
33 W. 39th St., New York, N. Y.

☐ .....copies paper covers (non members) $3.00 each
☐ .... (members) $1.50 each
☐ .... cloth .. (non members) $4.00 each
☐ .... (members) $2.50 each

Payment is enclosed herewith ☐

Name.....
Address.....Grade Membership.....
City.....

Deliver twice the volume of the Arkansas River *with One* ECONOMY PUMP

200,000 gallons a minute can be delivered by one Economy Axial Flow Pump!

That's double the mean discharge of the Arkansas River at La Junta, Colo.

For any high capacity, low head application, these pumps are ideal. Operating at high speeds they are light in weight and low in cost.

Installation is simple and inexpensive. No dry well is needed. Just drop pump into channel or wet well and connect Dresser coupling at discharge. It is not even necessary to accurately align piping.

Three general types are available: Light Duty for irrigation uses; Standard Duty for flood control; and Heavy Duty types for continuous service, such as condenser circulation. A special Heavy Duty "Pull-out" type is built to allow removal of shaft and rotor without disturbing piping.

Economy Axial Flow Pumps are made with either oil or grease lubricated bearings, water lubricated rubber bearings and open or enclosed shafts. Capacities range from 1,000 G.P.M. to 200,000 G.P.M. at heads up to 75 ft.

For complete details, write Dept. BK-6 for Bulletin No. G-845.

Centrifugal, Axial and Mixed Flow Pumps for all applications.

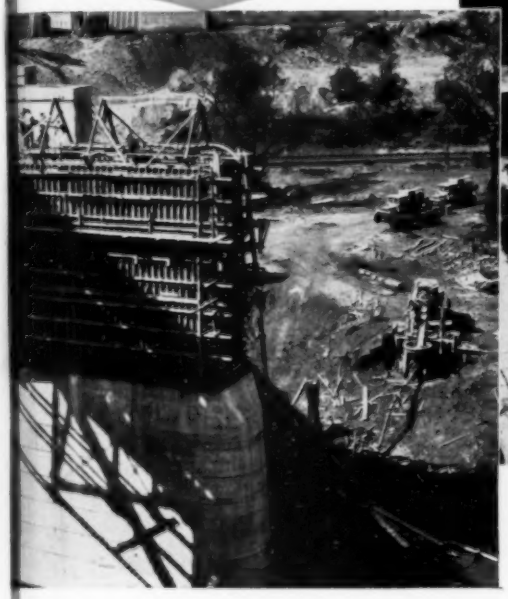
Economy Pumps Inc.

DIVISION OF HAMILTON-THOMAS CORP.
HAMILTON, OHIO

INDEX TO ADVERTISERS

ALLIS-CHALMERS MANUFACTURING COMPANY	65
AMERICAN BITUMULS COMPANY	59
AMERICAN BRIDGE COMPANY	2 and 3
AMERICAN MANGANESE BRONZE COMPANY	98
AMERICAN PAULIN SYSTEM	98
AMERICAN PIPE & CONSTRUCTION CO	81
AMERICAN STEEL & WIRE COMPANY	67
ARMCO DRAINAGE & METAL PRODUCTS, INC.	6
AUSTIN-WESTERN COMPANY	77
BARBER-GREENE COMPANY	7
BROWN & BROWN, INCORPORATED	96
CAST IRON PIPE RESEARCH ASSOCIATION	88 and 89
CATERPILLAR TRACTOR CO.	11
CEMENT GUN COMPANY	87
CHICAGO BRIDGE & IRON COMPANY	61
THE DORR COMPANY	8
DRILLED-IN CAISSON CORPORATION	90
EASTMAN KODAK COMPANY	85
ECONOMY PUMPS INC.	104
ELLICOTT MACHINE CORPORATION	94
FORT PITT BRIDGE WORKS	73
GENERAL ELECTRIC CO.	1
W. & L. E. GURLEY	95
IMPERIAL PENCIL TRACING CLOTH	92
INTERNATIONAL HARVESTER COMPANY	70 and 71
IRVING SUBWAY GRATING CO., INC.	96
KERLOW STEEL FLOORING CO.	93
KEUFFEL & ESSER CO.	92
THE KINNEAR MANUFACTURING CO.	75
WM. F. KLEMP COMPANY	98
KOPPERS COMPANY, INC.	97
LACLEDE STEEL COMPANY	80
LAYNE & LOWLER, INCORPORATED	94
THE LINCOLN ELECTRIC COMPANY	57
LOCK JOINT PIPE COMPANY	4th Cover
LONE STAR CEMENT CORPORATION	14
MACARTHUR CONCRETE PILE CORP.	92
THE MASTER BUILDERS CO.	3rd Cover
MERRITT-CHAPMAN & SCOTT CORPORATION	78
MORETRENCH CORPORATION	96
NATIONAL CLAY PIPE MANUFACTURERS, INC.	12
CHARLES F. ORVIS CO.	90
PENNSYLVANIA DRILLING CO.	94
PERMUTIT COMPANY	63
PORTLAND CEMENT ASSOCIATION	4
PROPORTIONEERS, INC.	82
RAYMOND CONCRETE PILE CO.	2nd Cover
RICHMOND SCREW ANCHOR CO., INC.	5
S. MORGAN SMITH CO.	10
SPENCER, WHITE & PRENTIS, INC.	87
SPRAGUE & HENWOOD, INC.	91
STANCAL ASPHALT & BITUMULS COMPANY	59
STANDARD OIL COMPANY (INDIANA)	9
JOHN W. STANG CORPORATION	90
STRATEX INSTRUMENT CO.	93
THE TEXAS COMPANY	13
UNDERPINNING & FOUNDATION CO.	96
UNION METAL MANUFACTURING COMPANY	16
U. S. PIPE & FOUNDRY COMPANY	69
U. S. STEEL CORPORATION	2, 3, and 67
VIBER COMPANY	79
DAVID WHITE COMPANY	91
R. D. WOOD COMPANY	83
YUBA MANUFACTURING CO.	84

POZZOLITH CONCRETE HERE . . .



Reading Railroad Co., Bridge, Across Schuylkill River, Reading, Pa. Private Plans. Contr.— Empire Construction Co., Baltimore, Md. Pozzolith Ready-Mixed Concrete supplied by Reading Ready-Mix Concrete Co., Reading, Pa.

In addition to producing the easy placeability and good cohesiveness required for this pumped concrete job, Pozzolith, cement dispersion, provided these important advantages:

1. REDUCED PLACING COSTS
2. DENSE, WATERTIGHT CONCRETE
3. GREAT DURABILITY

Pozzolith, Cement Dispersion, conforms with the water-cement ratio law — basis of ACI (613-44) and ASTM (C94-47T) methods for concrete design, specification and production. Pozzolith produces required concrete properties at lowest cost.

Write for further information and Pozzolith booklet.

MASTER BUILDERS

CLEVELAND 3, OHIO — TORONTO, ONTARIO

Whether your daily water consumption demands be 3,000,000 gallons or hundreds of times that figure, Lock Joint Pipe Company is prepared to provide a supply line for your requirements.

In the last few years the Company has supplied not only hundreds of miles of large diameter pipe but also more than a million feet of 16" to 24" pipe for municipalities and industry. This has been made possible through the establishment of three permanent manufacturing plants. Lock Joint Concrete Pressure Pipe from 16" to 42" in diameter, produced at these plants, can be shipped economically to all parts of the country —for both major installations and minor extensions.

Our representative will be glad to discuss with you any water supply or transmission project which calls for pressure pipe 16" in diameter or larger. You will find that Lock Joint Concrete Pressure Pipe's superior characteristics of long life, continuous high flow and negligible upkeep will recommend it above all others for any permanent water supply installation.

SCOPE OF SERVICES—Lock Joint Pipe Company specializes in the manufacture and installation of Reinforced Concrete Pressure Pipe for Water Supply and Distribution Mains in a wide range of diameters as well as Concrete Pipe of all types for Sanitary Sewers, Storm Drains, Culverts and Subaqueous Lines.

LOCK JOINT PIPE COMPANY

Est. 1905

P.O. Box 269, East Orange, N. J.

PRESSURE PIPE PLANTS: Wharton, N. J., Turner, Kan., Detroit, Mich.

BRANCH OFFICES: Cheyenne, Wyo. • Denver, Col. • Kansas City, Mo. Valley Park, Mo. • Chicago, Ill. • Rock Island, Ill. • Wichita, Kan. Kenilworth, N. J. • Hartford, Conn.

LOCK JOINT
Reinforced Concrete
PRESSURE PIPE